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THE EFFECT OF NON-PHARMACOLOGICAL INTERVENTIONS ON THE SEVERITY AND DURATION OF HYPOACTIVE DELIRIUM AND DELIRIUM IN POST-OPERATIVE CARDIO-THORACIC SURGERY PATIENTS

by

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Declaration

I declare that **THE EFFECT OF NON-PHARMACOLOGICAL INTERVENTIONS ON THE SEVERITY AND DURATION OF HYPOACTIVE DELIRIUM AND DELIRIUM IN POST-OPERATIVE CARDIO-THORACIC SURGERY PATIENTS** is my own work and that all source that have been used or quoted have been indicated and acknowledge by means of complete references and that this work has not been submitted for any other degree at any other institution.

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Name Date

This dissertation is dedicated to by daughter,

Liane' Kruger.

"Work willingly at whatever you do, as though you were working for the Lord rather than for people"

Colossians 3:23-34

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"I will lift up my eyes to the hills, from where shall my help come? My help comes from the Lord who made heaven and earth" Ps121:1-2

ABSTRACT

The prevalence of Hypoactive delirium and delirium in Intensive Care Units (ICU) can be as high as 80% and is characterized by decreased cognitive function, inattentive thinking, and fluctuation of consciousness, disorientation and confusion which could result in an increase of 6 months mortality and cognitive impairment. If no screening tool for detection for hypoactive delirium and delirium is utilized, it will be undetected and the outcome will be worse if no non-pharmacological interventions are in place.

The aim and objective of the study was to assess the effect of non-pharmacological interventions on the severity and duration of hypoactive delirium and delirium in ICU patients following cardio-thoracic surgery. The Quasi experimental non-equivalent control group design was used. The setting was a private hospital of 138 beds with 18 ICU beds based in Gauteng. The population was chosen by convenient sampling and consisted of post-operative Cardio-thoracic surgery participants who met the inclusion criteria and gave informed consent pre-operatively. The control group of 30 participants enrolled firstly. If the participants screened positive for hypoactive delirium or delirium on day 1 at 8:00 with screening utilizing the Intensive care delirium screen checklist (ICDSC), they were enrolled into the study and received standard nursing care. They were screened again at 16:00 with the ICDSC to assess the prevalence and duration of delirium or hypoactive delirium if no intervention was implemented. The intervention group was enrolled in the same manner and screened with the ICDSC at 8:00 and 16:00. They received non-pharmacological interventions instead together with standard nursing care. The difference in the ICDSC checklist scores was utilized for data analysis.

The results showed that the duration in hours from hypoactive delirium and delirium to no delirium in the intervention group (62,4 hours to no delirium) was significantly shorter than in the control group (72,3 hours to no delirium) thus therefore supported the hypothesis. Limitations to this study were that only one ICU unit in a private hospital was used with a small sample size consisting out of cardio-thoracic patients.

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Abbreviation/ acronym	Meaning
ICDSC checklist	Intensive Care delirium screening checklist
EN	Enrolled Nurse
ICU	Intensive Care Unit
PN	Professional nurse

CHAPTER 1 OVERVIEW OF THE STUDY

1.1 INTRODUCTION AND BACKGROUND

Delirium in totality commonly occurs in patients admitted in the intensive care unit (ICU). In post-operative participants especially, the estimated incidence can be as high as 80-87% (Barr & Pandharipande 2013:99). Delirium is characterized with a quick onset, depending on the patient's age, type of surgery, and type of anaesthesia used (Whitlock, Vannucci & Avidan 2011:448). Cardiac surgery participants have the highest risk for delirium with an incidence of up to 51% (Farris 2015:136; Vasilevskis, Han, Hughes & Ely 2012:279; Lahariya, Grover, Bagga & Sharma 2014:164; McPherson, Wagner, Boehm, Hall et al 2013:406). In addition Farris & Mattison 2014:7; Lipowski (1983:1426) identified three motoric subtypes of delirium, namely hyperactive, hypoactive and mixed delirium. Identification of delirium subtypes is important because it helps in the treatment, indicating the cause, outcome and prognosis of delirium (Grover, Kumar & Chakrabarti 2011:279).

Delirium is much easier to identify in Intensive Care (ICU) patients, as the characteristics are agitation, restlessness, attempting to remove lines and catheters, and emotional liability (Lipowski 1983:1426). Hypoactive delirium is characterized by lethargy, withdrawal, flat affect, apathy and decreased responsiveness (Lipowski 1983:1426). Mixed delirium is characterized by fluctuation between lethargy and agitation delirium (Lipowski 1983:1426; Pun & Ely 2007:624; Salluh, Soares, Teles, Ceraso et al 2010:210; Sandeep, Sharma, Aggarwal, Surendra et al 2014:290; Grover, Sharma, Aggarwal, Mattoo et al 2014:290).The three subtypes of delirium differ in severity and prevalence of psychotic symptoms, sleep disturbance, thought dysfunction and fluctuation of symptoms, and all levels have a cognitive disturbance which are the core characteristics of delirium (Pun & Ely 2007:624; Salluh et al 2010:210; Sandeep et al 2014:290; Grover et al 2014:290). The severity and frequency of symptoms change over time and become worse (Grover et al

2014:289). Intensive care patients experience hypoactive delirium the most frequently and this form of delirium is more difficult to detect if they are not assessed for hypoactive delirium, using the Intensive Care delirium screening checklist (ICDSC) (Pun & Ely 2007:625). For this reason, the focus of this study was on assessing patients for hypoactive delirium and delirium utilizing the ICDSC checklist, because a patient can change from hypoactive delirium to delirium and vice versa at any given time and create the necessity to screen for both and create awareness amongst ICU nurses. These patients present with lethargy and agitation and are more difficult to identify (Shaughnessy 2012:8; Barr & Pandharipande 2013:102) and these episodes of hypoactive delirium usually go undetected by ICU nurses (Speed 2015:93).

Intensive care nurses should therefore routinely screen participants for hypoactive delirium and delirium and implement non-pharmacological interventions to decrease the severity of hypoactive delirium (Speed 2015:94). These interventions, such as hourly reorientation, noise control and sleep hygiene, may in turn decrease the level of sedation needed; decrease the length of hospital stay; increase the mental status, and decrease the mortality rate of patients presenting with hypoactive delirium in the intensive care environment (McPherson et al 2013:405; Vasilevskis et al 2012:277; Barr & Pandharipande 2013:109; Pipanmekaporn, Wongpakaran, Mueankwan et al 2014:879).

1.2 RATIONALE FOR THE STUDY

Globally, a validated tool, namely the ICDSC screening tool, is utilized to screen patients' daily to assess the severity and duration of hypoactive delirium and delirium as part of the daily assessment. Implementation of non-pharmacological interventions forms part of daily nursing care to reduce hypoactive delirium and delirium globally. However, this is not current practice in most of the South African ICU context. In most South African ICUs, patients are not assessed for hypoactive delirium and delirium and no prevention practices are in place to limit the incidence and duration of hypoactive delirium and delirium. Therefore the researcher wished to screen post-cardiothoracic patients admitted in a

specific intensive care unit for hypoactive delirium and delirium, using the ICDSC screening checklist. Non-pharmacological interventions were implemented and compared to standard nursing care amongst postoperative cardio-thoracic patients.

Intensive care nurses play a vital role in the screening of intensive care patients for hypoactive delirium and delirium using the ICSDC checklist. Hypoactive delirium and delirium can be detected early and non-pharmacological interventions implemented to decrease the severity of hypoactive delirium and delirium. This, in turn, may result in improved patient outcomes in terms of decreased level of sedation needed, shorter length of hospital stay, increased mental status, and decreased mortality rate (Ely & Pun 2002:2; Vasilevskis et al 2012:277; Barr & Pandharipande 2013:109; McPherson, Wagner, Boehm et al 2013:405; Pipanmekaporn et al 2014:879). These outcomes following the implementation of non-pharmacological interventions may, in turn, result in decreased hospital costs and a decrease in the incidence of hospital-acquired infections (Salluh et al 2010:210).

1.3 PROBLEM STATEMENT

Patients admitted to ICUs have an 80% risk to develop hypoactive delirium and delirium (Barr & Pandharipande 2013:109; Pipanmekaporn et al 2014:879). Globally, the assessment for hypoactive delirium and delirium and the implementation of non-pharmacological interventions form part of the management of intensive care patients to decrease the duration and severity of hypoactive delirium and delirium (Pun & Ely 2007:625; Salluh et al 2010:210; Speed 2015:94).

Currently in most of the intensive care units in South Africa, including the selected ICU unit, patients are not screened for hypoactive delirium and delirium as part of the daily assessment and ICU nurses are not aware of delirium screening, delirium prevention and different delirium subtypes. Therefore hypoactive delirium and delirium is under-diagnosed, which can lead to over-sedation, decreased mental function, increased length

of hospital stay, complications and an increase in long-term mortality (Vasilevskis et al 2012:277; Lahariya et al 2014:164). Early diagnosis of hypoactive delirium and delirium and the implementation of non-pharmacological interventions by the nurse practitioner are directly linked to improved patient outcomes (Pun & Ely 2007:625; McPherson et al 2013:405; Vasilevskis et al 2012:277; Pipanmekaporn et al 2014:9:879; Barr & Pandharipande 2013:109).

1.4 AIM AND OBJECTIVES

The aim of the study was to assess the effect of non-pharmacological interventions on the severity and duration of hypoactive delirium and delirium in ICU patients following cardio-thoracic surgery.

The objectives of the study were to assess

- Assess the prevalence of hypoactive delirium and delirium during pre-test scoring with the ICDSC tool at 08:00 on post-operative cardio-thoracic patients.
- Assess the effect of implementation of non-pharmacological interventions nursing care versus standard nursing care on the severity and duration of hypoactive delirium in hours on ICU patients following cardio-thoracic surgery.
- Assess the effect of implementation of non-pharmacological interventions nursing care versus standard nursing care on the severity and duration of delirium in hours on ICU patients following cardio-thoracic surgery

1.5 RESEARCH QUESTION

What is the effect of non-pharmacological interventions on the severity and duration of hypoactive delirium and delirium in patients admitted to ICU following cardio-thoracic surgery?

1.6 HYPOTHESIS

A hypothesis is a proposed explanation for a phenomenon (Bothma et al 2010:174). In research, a hypothesis is tested by drawing conclusions from it (Bothma et al 2010:174). In this study, the hypothesis is that the implementation of non-pharmacological interventions would reduce the severity and duration of hypoactive delirium and delirium amongst post-operative cardio-thoracic patients.

1.7 ASSUMPTIONS

Assumptions are basic principles that are assumed to be true based on logic and reason, without proof or verification (Brink, Van der Walt & Van Rensburg 2006:25). During the control group investigation, the intensive care bedside nurses would perform the standard nursing care in a similar manner to all cardio-thoracic participants. Training was provided to all intensive care nurses on screening for hypoactive delirium and delirium and the implementation of non-pharmacological interventions. This would ensure that all participants in the intervention group received similar interventions. The assumptions were that the intervention group duration and severity will be shorter if non-pharmacological interventions were implemented compared to the control group which received only standard care.

1.8 DEFINITIONS OF KEY TERMS

In this study, the following key terms were used as defined below.

1.8.1 Delirium: Delirium is characterized by agitation, restless, attempting to remove intravenous lines and catheters, emotional liability (Mistraletti et al 2012:312;Barr 2013:102; Shaughnessy 2012:8)The Intensive Care Delirium Screening Checklist (ICDSC)

would be used to screen participants for delirium. A score of 3-8 would indicate delirium (Bergeron et al 2001:862; Ouimet et al 2007:1007).

1.8.2 Duration: Participants admitted in the intensive care following cardio-thoracic surgery were assessed for hypoactive delirium and delirium with the use of ICDSC checklist every day from day 1 post-operative at 8:00 and 15:00 to determine if the duration and severity of hypoactive delirium and delirium had decreased to a score of zero on the ICDSC checklist, with the implementation of non-pharmacological interventions.

1.8.3 Hypoactive delirium (sub-syndromal delirium): Hypoactive delirium is characterized by lethargy, withdrawal, flat affect, apathy and decreased responsiveness (Lipowski 1983:1426; Pun & Ely 2007:625). Participants admitted to the ICU following cardio-thoracic surgery were assessed for hypoactive delirium and delirium using the Intensive Care Delirium Screening Checklist (ICDSC). A score of 1-3 (on the 8-point scale) would indicate hypoactive delirium and a score of 3-8 would indicate delirium (Bergeron et al 2001:862; Ouimet et al 2007:1007).

1.8.4 Intensive care nurse: A professional nurse (PN) and/or an enrolled nurse (EN) is defined by the Nursing Act (33 of 2005) as “nurses who will be responsible for nursing actions of a patient”. A bedside nurse in this study was either a PN or an EN responsible for the nursing care of ICU participants following cardio-thoracic surgery.

1.8.5 Non-pharmacological interventions: Non-pharmacological interventions refer to interventions that can be implemented by the nurse practitioner without a prescription from the doctor, as they do not include any medications. The following are non-pharmacological interventions: i) providing visual (glasses) and/or hearing aids, where applicable; ii) communicating and hourly reorientation of the patient; iii) family objects (photos) next to the patient’s bedside; iv) playing classical music; v) ensuring a quiet environment; vi) implementing sleep hygiene 13:00-14:00; vii) minimizing physical restraints; viii) assessing sedation score; ix) advocating for early removal of invasive lines; x) mobilizing twice daily,

and xi) extending visiting times (Martinez et al 2012:630; Rivosecchi et al 2015:47;Shaughnessy 2002:1475) (see Annexure D). For the purpose of this study, the non-pharmacological interventions included the above.

1.8.6 Severity: Participants admitted in the ICU following cardio-thoracic surgery were assessed for hypoactive delirium and delirium using the Intensive Care Delirium Screening Checklist (ICDSC). A score of 1-3 (on the 8-point scale) would indicate hypoactive delirium and a score of 3-8 would indicate delirium Severity was determined by the score calculated according to the ICDSC scale. A score of 0 (zero) indicated no hypoactive delirium and a score of 3 indicated hypoactive delirium. The ideal score therefore should be 0 (zero) (Bergeron et al 2001:862; Ouimet et al 2007:1007).

1.9 THE SETTING

The setting is defined as to "the site or location used to conduct a study" (Burns & Grove 2014:373). The setting of the research project was done in a private hospital in the province of Gauteng. This private hospital consists out of 138 beds and 3 intensive care units. The project was only conducted in the one unit, the cardio-thoracic unit. The intensive care unit which was utilized consisted out of 18 beds with Professional nurses and Enrolled nurses. There are four cardio-thoracic surgeons working in this unit and the bed occupancy ranges between 95-100%. The nurse to patient ratio is 1 ICU patient to 1 ICU nurse and 2 high care patients to 1 ICU nurse. The patients usually stayed 3 to 4 days in ICU before being transferred to the ward.

1.10 DELIMITATION

The study was only conducted in one 18 bed cardiothoracic ICU of a specific private hospital. The study participants were adult patients who had undergone cardio-thoracic surgery. The study was conducted over a period of 3 months as indicated in the lay out in figure 1.1 below.

1.11 RESEARCH DESIGN

A research design is “a set of logical steps taken by the researcher to answer the research question” (Brink et al 2006:92). The researcher selected a quasi-experimental non-equivalent control group design for the study (Babbie 2010:371; Polit & Beck 2016:266). Non-equivalent control group pre-post-test designs are frequently used and involve an experimental treatment and two groups of subjects observed before and after its implementation (Polit & Beck 2016:266). This will result in the baseline data which is as similar as possible at the onset of the study with the help of inclusion and exclusion criteria (Polit & Beck 2016:266). In the following figure 1.1 the quasi-experimental design and how the study was conducted, shall be discussed.

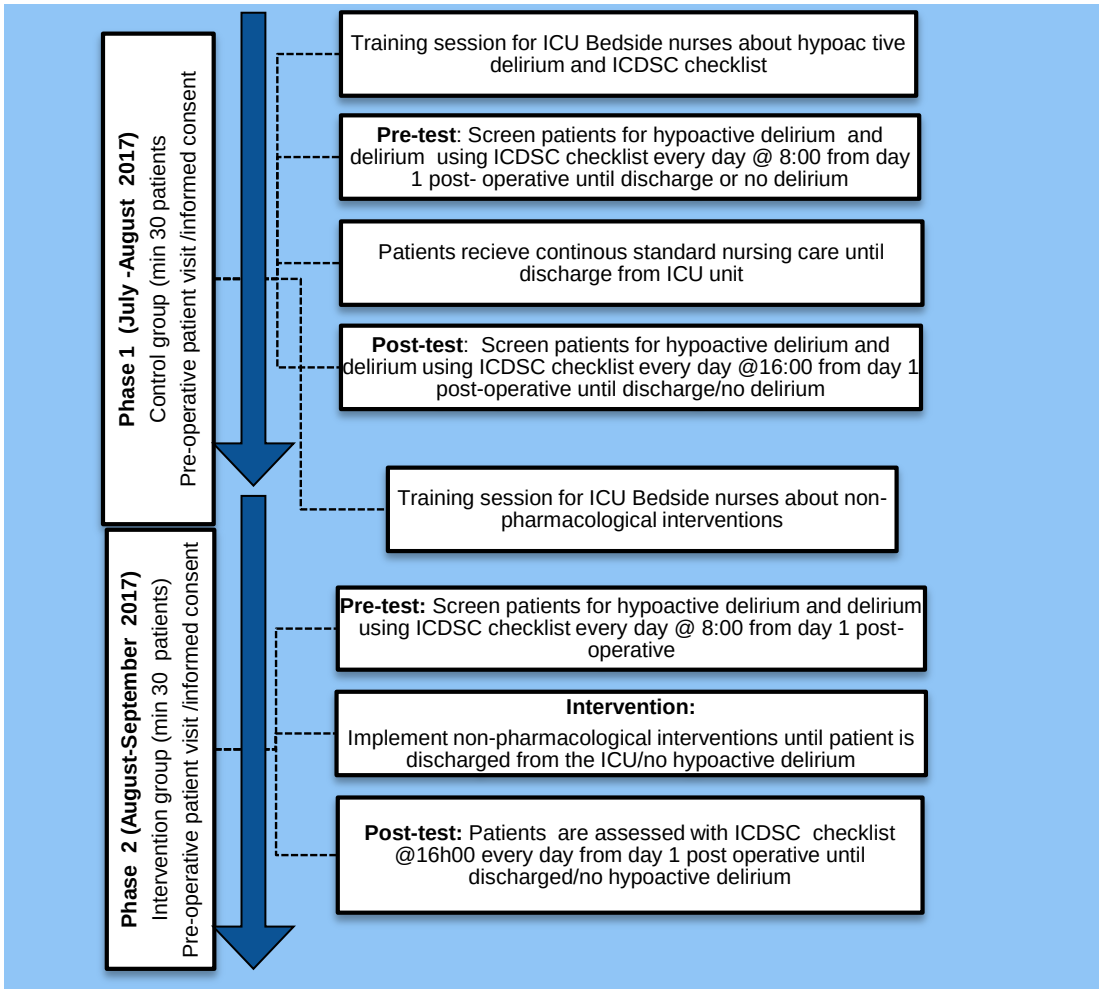

Figure 1.1 a Quasi-experimental non-equivalent control group design.

1.12 RESEARCH METHODS

The research methods will be discussed in detail in chapter 3. The research methods are the plan for conducting the specific steps of a study (Burns & Grove 2014:707). Research methods are the techniques used to structure a study and to collect and analyse data relevant to the research questions systematically (Polit & Beck 2016:741). The research methods include the setting, population, sampling and sample, data collection and analysis which are tabulated in table 1.1 below.

Research method	Discussion
Population	Inclusion criteria: Older than 18 years, admitted for cardio-thoracic surgery, able to understand instructions, read and speak English. Exclusion criteria: Known history of dementia, neurological disorders, alcoholism, psychosis and over sedated post-operative with a sedation score of -4.
Sample	Convenient sampling was used where the participants who agree to participate were enrolled and who meet the inclusion criteria. A sample size of a minimum of 30 participants per group.
Data Collection	Intensive Care Delirium Screening Checklist (ICDSC) was used to assess for hypoactive delirium and delirium. ICDSC scores were done twice a day (08:00 and 16:00) for a minimum of 3 days (6 sets of data) on each patient who was enrolled pre-operatively. Hypoactive delirium was a score of 1-3 and delirium was a score of 4-8. The pre-and post-operative risk factor checklist was also utilized to collect data.
Data Analysis	Changes in delirium score between the intervention and control group was compared with respect to change from baseline, using a two-tailed two sample T-test assuming unequal variance. Descriptive statistics were used to describe the incidence of hypoactive delirium and delirium

Table 1.1The research methods tabulated

In the figure 1.2 below the selection process is indicated how participants were selected.

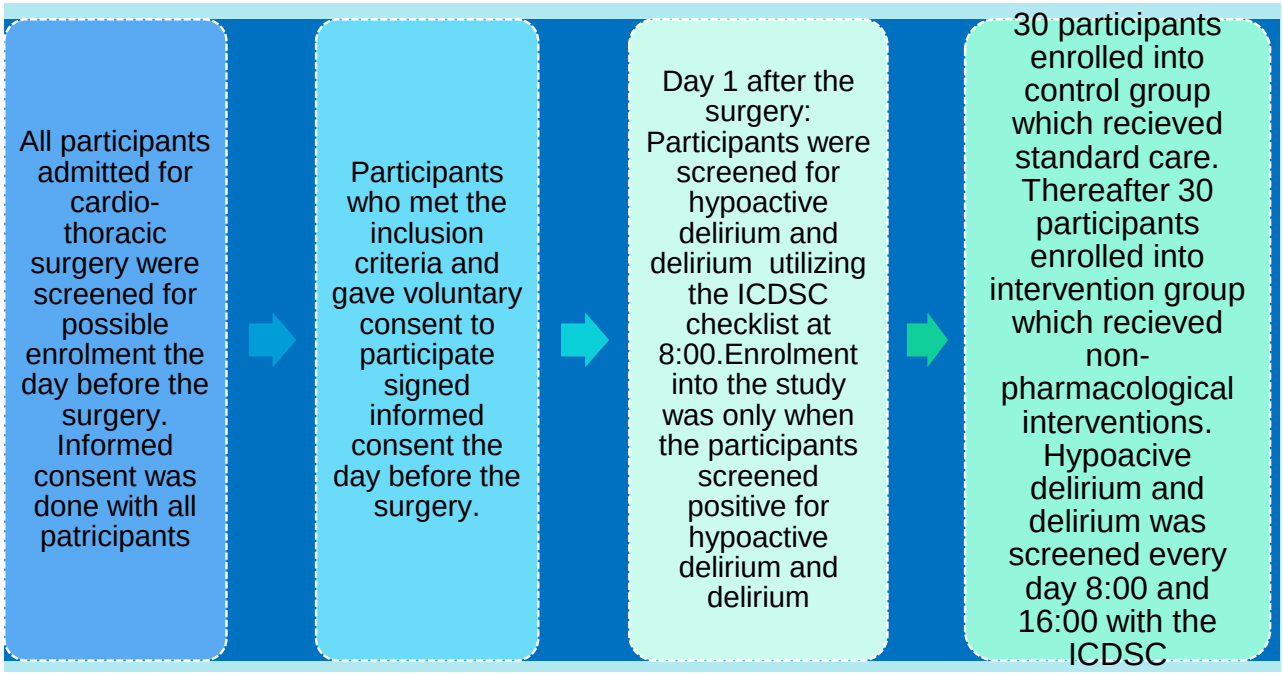

Figure 1.2 indicates the selection process.

1.13 ETHICAL CONSIDERATIONS

The participants' right to self-determination, privacy, autonomy, confidentiality, full disclosure about the study, and protection from discomfort and harm was ensured throughout the study (Burns & Grove 2009:190-199) and will be discussed. When humans are used as study participants care must be taken in ensuring that their rights are protected (Polit & Beck 2012:166). Research should not only benefit the researcher but the community and should improve existing services (Bothma et al 2010:5).

1.13.1 Permission

The researcher applied for and obtained permission to conduct the study from the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (179/2017) and from the selected private hospital in Gauteng province (see Annexure A1 and A2). Permission was obtained to access the ward during the pre-operative visit the day before the surgery was informed consent was obtained. The researcher obtained permission from the hospital and nursing manager as well as the unit managers. Access into the ICU was

obtained via permission from the unit manager and staff for the ICDSC screening and implementation of interventions in the intervention group.

1.13.2 Informed consent

Accordingly, the researcher obtained permission to conduct the study, obtained informed consent from the participants, and observed the ethical principles of beneficence, respect for persons and justice (Polit & Beck 2012:748). The researcher obtained informed consent from the patients, the day prior to the surgery when they were admitted for pre-operative investigations and preparation. This ensured that the patients gave informed consent as they would not have received any sedation, analgesia or narcotics that might influence their judgement. Participants in the control group signed informed consent which stipulated that standard nursing care was assessed. The intervention group signed informed consent which stipulated the implementation of non-pharmacological interventions post-operatively (see Annexure F1 and F2). A copy of the informed consent was given to the patient and a copy was signed for the researcher. On the informed consent it was stated that the patient will only be enrolled into the study if he/she screened positive for hypoactive delirium or delirium 2 hours after extubation. It was explained to the patient that he/she could withdraw at any time from the study without any fear of prejudice.

The nurses could have felt that they were forced by the researcher and had to participate in the study. To overcome this researcher collaboratively included ICU bedside nurses in the study and explained the importance, significance and complications of hypoactive delirium and delirium on patients experiencing it. The researcher did not force any ICU nurse to participate in the study and did not discriminate against those who refused. The bedside ICU nurses who assisted the researcher to screen for hypoactive delirium and delirium and implemented normal standard nursing care and later non-pharmacological interventions also signed informed consent (see Annexure F3).

1.13.3 Confidentiality and Anonymity

The confidentiality of the selected private hospital and the participants was respected by not mentioning any names on the documentation completed by the researcher only numbers was used. Because the study could not be randomized due to the layout of the unit, the participants identities could not be kept confidentially to the nursing staff because they had to be identified for other nursing procedures. Confidentiality was only respected and not assured. The documentation the researcher utilized only had a number on. Only the researcher kept the original list of participants correlating with the list of names of participants as well as the ICDSC scores was kept by the researcher for confidentiality. The nursing staff was although trained about how to complete the ICDSC screening checklist and how the score improved during the course of the day was inevitable for the nursing staff to see and be trained on. The participants were reassured that the data would be treated in strict confidentiality and no one would have access to the data. Anonymity could not be assured because the study could not be randomized due to the layout of the unit. ICU bedside nurses had to identify participant to render nursing care because participants was not admitted only for the research project but to undergo surgery.

1.13.4 Beneficence

The ethical principle of beneficence “holds that one should do well and, above all, do no harm” (Burns & Grove 2013:687). This principle emphasises the importance of securing the well-being of participants who have the right to be protected from discomfort and harm (Polit & Beck 2012:152). The participants were screened for hypoactive delirium and delirium post-operatively and interventions were implemented or normal standard nursing care was rendered. There was no anticipated discomfort or harm to the participants. No harm was done to any of the participants because nursing interventions was implemented that could only benefit the participant and not harm him/her in any way.

1.13.5 Respect for human dignity

Respect for human dignity includes the right to self-determination and full disclosure (Polit & Beck 2012:154). The researcher treated the participants as autonomous agents

capable of making their own informed decisions. The researcher informed the participants of the nature, purpose and significance of the study as well as the expected benefit to the ICU patients and the particular hospital. The participants were allowed to ask questions to clarify any uncertainties before they were asked to sign the informed consent form (see Annexure B1/C1). . ICU patients are vulnerable and if they screened positive for hypoactive delirium and delirium they would have been more vulnerable. The nursing act nr 33 of 2005 regulation scope of practise R2598 governess nursing care rendered to a vulnerable patient that should be treated with the utmost respect and dignity. This was adhering to by the researcher and ICU nursing staff as it is governed by the nursing council. This was explained to the patient in the informed consent as well they will be handled with respect and dignitary as it is a patient right as well.

1.13.6 Justice

The principle of justice indicates research participants' right to fair treatment and privacy. Consequently, the private hospital involved was not named and the participants in the control and intervention groups were treated confidentially and could not be traced as their hospital numbers were not documented. The researcher kept all the data under lock and key and strictly confidential. The time and date of the study were negotiated with the ICU bedside nurses and did not interfere with patient care.

1.14 LAYOUT OF THE STUDY

The study consists of five chapters. Figure 1.3 illustrates the layout of the study.

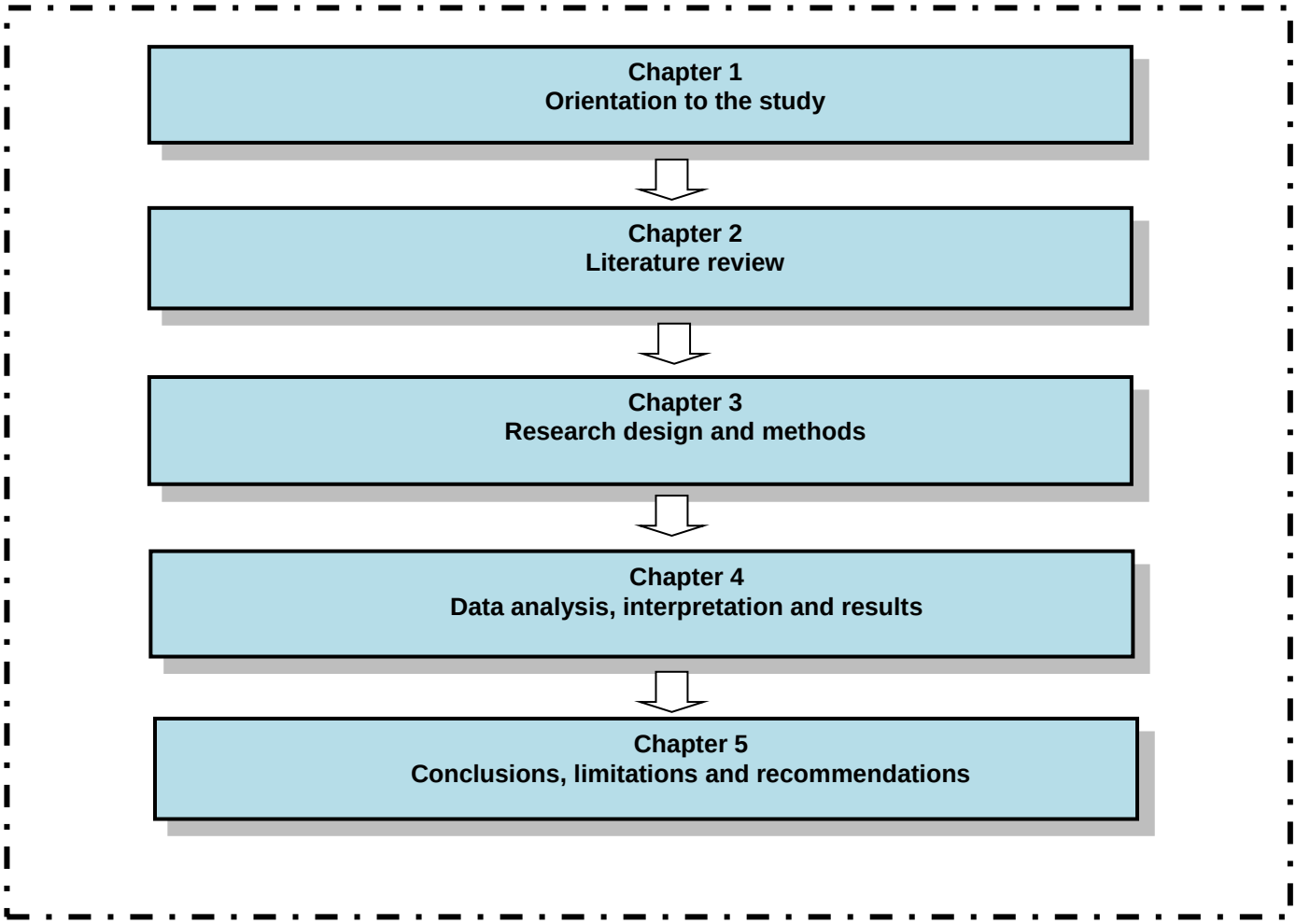

Figure 1.3 layout of the study

1.15 CONCLUSION

This chapter outlined the background to and aim and objectives, research design and methods of the study. In chapter 2 the literature review pertaining hypoactive delirium and delirium will be conducted.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided an overview of the study. This chapter discusses the literature review conducted for the study. A literature review involves researching, reading and understanding literature relevant to the study (Brink, van der Walt & van Rensburg 2006:55). The literature review covered hypoactive delirium and delirium; subtypes, characteristics and causes of delirium; risk factors; complications; decreasing complications; strategies to limit hypoactive delirium and delirium; prevention of hypoactive delirium and delirium; delirium screening, non-pharmacological interventions and pharmacological treatment.

2.2 INCIDANCE OF HYPOACTIVE DELIRIUM AND DELIRIUM

Intensive care patients who are ventilated or not ventilated experience hypoactive delirium and delirium (one of 3 forms of delirium) as the most frequent form of delirium which is very difficult to detect (Ely 2002:5). In the cardiac surgery intensive care unit (ICU), 1 out of 4 patients will experience delirium in their ICU stay of more than 24 hours and specifically hypoactive delirium will remain unrecognized in 75% of cases when delirium screening is not done (McPherson, Wagner, Boehm, Hall et al 2013:408). Delirium and particularly hypoactive delirium and delirium are frequently missed in ICU units, which results in increased length of stay in the ICU and increased financial implications for the patient. Consequently, a validated screening tool should be used to identify hypoactive delirium and delirium especially (Neufeld, Nelliot, Inouye, Ely et al 2014:1513; Brown, Lamflam, Max, Lymar et al 2016:1663).

Delirium care bundles should also be implemented in an ICU unit to limit the risk of delirium occurrence and especially hypoactive delirium and delirium (Hsieh, Ely & Gong

2013:654). Delirium is usually prevented by pharmacological interventions and very few preventive strategies are based on non-pharmacological interventions that assist ICU patients to limit the development of delirium which presents as a risk (Hsieh, Ely & Gong. 2013:654). Monitoring and implementation of these non-pharmacological interventions are not routinely practised and should be integrated as part of daily ICU care as a delirium care bundle (Hsieh, Ely & Gong 2013:654). A change in nursing care is necessary to create a pleasant environment and decrease the environmental factors on the patient's cognitive state and has been found to reduce delirium in ICU patients (Tovar, Suarez, Munoz et al 2016:74).

Delirium can occur in as high as 50% of all ICU patients during their ICU stay and as high as 80% of mechanically ventilated patients experience delirium, usually with a quick onset (Barr, Kishman & Roman 2013:282). Patients may never return to their pre-delirium mental state after a delirium incident and the duration of delirium is linked to smaller brain volume up to three months after discharge (Jones & Pisani 2012:146; Gunther 2012:2032). A study on the predictors, prevalence and detection of delirium in an adult acute hospital population found that 20% of all patients experience delirium at some time in their hospital stay (Ryan, O'Regan, Caiomh, Clare et al 2015:6). An international study on delirium epidemiology in critical care found a 32% delirium prevalence in general ICU patients where the diagnosis of delirium was associated with poor health outcomes such as longer ICU stay and increased short term mortality increases (Salluh, Soares, Teles, Ceraso et al 2010:210).

Delirium among mechanically ventilated patients was associated with higher mortality rates and longer lengths of stay in ICU as well as the number of days of delirium are increased because of longer sedation usage (Ely, Shintani, Truman, Speroff et al 2004:1760). The longer patients experience delirium, the higher the mortality and long-term cognitive impairment (Ely, Shintani, Truman, Speroff et al 2004:1753; Salluh et al 2010:2). Delirium is directly connected with poor health outcomes such as death (Salluh et al 2010:210). The longer the patient experiences delirium, the worse the outcome for basic daily motor and sensory function and not just higher mortality and cognitive decline

(Salluh et al 2010:210). These patients will need assistance in basic activities of living and will not be able to be independent anymore (Brummel, Jackson, Pandharipande, Thompson et al 2014:2).

One subtype of delirium, hypoactive delirium, is very difficult to detect if no assessment tool is used; it also has a worse outcome and usually goes undetected by intensive care nurses (Speed 2015:93). These patients present with lethargy and agitation because this type of delirium is difficult to identify and are misdiagnosed in 75% of cases in the absence of active delirium monitoring (Ely 2002:2; Barr, Fraser, Puntillake, Ely et al 2013:302; Shaughnessy 2012:8). It is characterized by acute cognitive dysfunction which is the result and end product of continuous insults to the brain that lead to end-organ brain injury which do not have just one cause (Ely 2002:2; Salluh et al 2010:210; Grover, Sharma, Aggarwal, Mattoo et al 2014:289; Vasilevskis et al 2012:277; Cerejeira, Nogueria, Luis et al 2012:669). End organ failure results in decreased mental function, longer hospital stay, and complications of increased hospital stay such as infections and increased long-term mortality (Vasilevskis et al 2012:277).

In China, Zhang, Sun, Liu, Qiu, Ye et al (2015:83) found that if risk factors were identified, post-operative delirium could be reduced after coronary artery bypass graft surgery by assessing and managing pain, early catheter removal, more family visits, reorientation, less care-related interruptions, optimizing comfort, monitoring sleeping difficulties, all of which are non-pharmacological. In this study, the Intensive Care Delirium Checklist (ICDSC) was utilized to detect delirium because it is the only validated checklist that can identify hypoactive delirium and delirium clearly. With the Confusion Assessment Method for ICU (CAM ICU), only delirium in totality is identified (Bergeron, Dubois, Dumont et al 2001:862; Ouimet, Riker, Bergeron et al 2007:1007).

2.3 CHARACTERISTICS OF HYPOACTIVE DELIRIUM AND DELIRIUM

Delirium is a disconnection syndrome with disturbance of neural information and has a rapid onset, inattention, altered level of consciousness and fluctuation of mental state where dementia has a gradual onset, memory disturbances, intellectual impairment, and personality and mood disturbances (Van Dellen, van der Kooi, Numan et al 2014:328; Ely 2002:5; Mashour & Avidan 2014:214). Delirium is characterized by acute brain dysfunction with decreased cognitive function, disorientation, confusion, inattentive thinking, fluctuation of consciousness, inattention with reduced ability to direct, focus, sustain and shift attention, and perception changes that are sudden where dementia changes are gradual over a longer period of lime (Vasilevskis et al 2012:277).

Delirium has the following characteristics (American Psychiatric Association [APA] 2013):

- A disturbance in attention (i.e. reduced ability to direct, focus, sustain, and shift attention) and awareness (reduced orientation to the environment).
- The disturbance develops over a short period of time (usually hours to a few days), represents a change in baseline attention and awareness and tents to fluctuate in severity during the course of the day
- An additional disturbance in cognition (e.g. memory deficit, disorientation, language, visuospatial ability or perception). The disturbances in criteria 1 and 2 are not better explained by another pre-existing, established or evolving neurocognitive disorder.
- There is evidence from the history, physical examination or laboratory findings that the disturbance is directly a physiological consequence of another medical condition, substance intoxication or withdrawal (i.e. because of a drug of abuse or a medication), or exposure to a toxin or because of multiple aetiologies.

Delirium is a cognitive impairment and the degree of impairment differs throughout the subtypes (Grover et al 2014:281). Clinical manifestations of delirium consist of decreased brain functions that present as inattentive thinking, fluctuation of consciousness, disorientation, confusion that can be summarized as attention, space-time orientation, memory especially short term, attention span and behaviour changes (Vasilevskis et al

2012:277). A reduced level of consciousness can be called hypoactive delirium, where agitation and increased motor activity can be called hyperactive delirium (Cunningham, MacLullich 2013:1). Patients with delirium lose links with reality and the symptoms appear as inability to recognize people/figures, anxiety and agitation, disorder of sleep-wake cycle where asleep in the day and awake at night, altered psychomotor behaviour, attempts to escape from environment, removal of medical devices, disorders of speech (Mistraletti, Pelosi, Mantovani et al 2012:312). The most consistent symptom is cloudiness of the consciousness that can develop to drowsiness, stupor and coma (Mistraletti et al 2012:313). The sudden disorientation of a patient to his/her own person, to time and space and be able to think logical, can create anxiety and agitation in that patient (Mistraletti et al 2012:313). Patients should have evidence of deterioration of cognitive abilities with inattention as main symptom, disorientation in visuospatial area and evidence of impairment of memory or comprehension to diagnose delirium (Meager, MacLullich & Luarila 2008:212). Where dementia is suspected, disorientation and memory disturbance are less accurate (Meager et al 2008:212).

2.4 SUBCLASSIFICATION OF TYPES OF DELIRIUM

There are three forms or subtypes of delirium, namely hyperactive, hypoactive and mixed delirium. Cognitive disturbance is the core clinical feature of delirium in all three classes (Grover et al 2014:289). The three classes differ the most in the severity and prevalence of psychotic symptoms, sleep disturbances, thought dysfunction and fluctuation of symptoms, and all levels have a cognitive disturbance which is the core characteristics of delirium (Sandeep, Sharma, Aggarwal, Surendra et al 2014:290; Grover et al 2014:290; Ely 2002:2; Salluh et al 2010:210). The severity and frequency of symptoms change within the 3 classes (Grover et al 2014:289). Identification of delirium subtypes is important because it helps in the treatment, understanding the cause, outcome and prognosis of delirium (Grover et al 2014:289). The three forms of delirium are motoric subtypes, but the problem is subjective evaluation of symptoms by the examiner and the use of assessment tools that are not specifically standardized for measuring motoric subtypes, like the CAM ICU tool only measures delirium in totality not in subtypes where

the ICDSC checklist differentiate between subtypes on the basis of motoric subtypes (Grover et al 2014:287). The amended delirium motor subtype scale (DMSS) is a validated tool to detect the motoric subtypes of delirium across different patient settings (Grover et al 2014:287). All patients within all the subtypes of delirium should receive reorientation to improve delirium outcome (Grover et al 2014:290). Table 2.1 presents the subtypes of delirium according to characteristics.

Table 2.1 Delirium subtypes according to characteristics

Characteristics	Delirium	Hypoactive delirium	Mixed delirium
Symptoms	Agitation, restless, attempting to remove intravenous lines/catheters,emotional liability (Mistraletti et al 2012:312;Barr 2013:102; Shaughnessy 2012:8)	Lethargy, withdrawal, flat affect, apathy, decreased responsiveness (Barr 2013:99, 102; Shaughnessy 2012:8)	Thought process dysfunction more common (Sandeep et al 2014:290) Fluctuation of symptoms between lethargy and agitation (Atalan, Efe, Akgun et al 2013:933)
Severity of symptoms	Symptoms severe (Sandeep et al 2014:290)	Symptoms only detected with the use of a screening tool (Sandeep et al 2014:290)	Symptoms not so severe as hyperactive delirium (Sandeep et al 2014:290)
Cognitive impairment	There is cognitive impairment, but hyperactive delirium is diagnosed and treated quicker (Grover 2014:289)	More severe cognitive impairment due to under-diagnosis (Grover 2014:289)	Cognitive impairment is variable according to the severity and duration of delirium (Grover 2014:289)

Characteristics	Delirium	Hypoactive delirium	Mixed delirium
Psychotic symptoms	Highest incidence of severity and prevalence of psychotic symptoms (Sandeep et al 2014:290) Delusion, hallucination more prevalent (Grover et al 2014:289)	Less delusions and hallucinations than hyperactive and hypoactive delirium (Grover et al 2014:289)	More delusions and hallucinations than hypoactive delirium (Grover et al 2014:289)
Sleep wake cycle disturbance	More frequently (Grover et al 2014:289)	Less frequent than hyperactive and mixed delirium (Grover et al 2014:289)	More frequent than hypoactive delirium (Grover et al 2014:289)
Pharmacological treatment	Necessary to treat patients with pharmacological treatment due to the risk of harming themselves, pulling out lines/catheters (Grover et al 2014:280)	Managed less efficiently with pharmacological treatment because patients do not harm themselves by pulling out lines, falling out of bed (Grover 2014:280)	Necessary to treat patients with pharmacological treatment due to the risk of harming themselves, pulling out lines/catheters (Grover et al 2014:280)
Identifiable in intensive care patients	Easily identifiable without a screening tool (Ely 2002:5)	Difficult to detect, goes undetected, most frequent form of delirium in ICU Salluh 2010:210; Grover 2014:289)	Easily identifiable (Ely 2002:5)

Characteristics	Delirium	Hypoactive delirium	Mixed delirium
Prevalence among intensive care patients	Post-operative prevalence was 70.7% of patients with hyperactive delirium (Atalan et al 2013:933).	1 out of 4 cardiac surgery patients develop hypoactive delirium (McPherson et al 2013:408). Due to increase Benzodiazepine and physical restraints used (McPherson et al 2013:410).	The prevalence of post-operative mixed delirium is 9.5% of patients (Atalan et al 2013:933).

2.5 PATHOPHYSIOLOGY OF ALL TYPES OF DELIRIUM

The mechanism of delirium is multifactorial, but mainly thought to be imbalances in neurotransmitters that modulate cognition, behaviour and mood (Atalan et al 2013:936). Delirium can be causes by a medical condition, substance withdrawal or intoxication, use of medication, toxin exposure or a combination of these factors (Ely 2002:5). One of the causes of delirium is associated with the unbalance in the inflammatory response and dysfunctional interaction between cholinergic and immune systems (Cerejeira et al 2010:737).

The pathophysiology of delirium is difficult to understand for three reasons: (1) the nature of the core feature, impaired level of consciousness and inattention, is difficult to determine; (2) symptoms are difficult to detect due to the severity and worsening of symptoms which fluctuate usually during the course of the day, and (3) multiple environmental and individual factors contribute to delirium but the inaccessibility of the

nervous system limits the correlation of the cognitive function during delirium (Cerejeira et al 2010:737). In cardiac surgery, the hypothesis is that the stress associated with the surgery and the cardio-pulmonary bypass machine result in systemic inflammatory response release of chemokines, cytokines and other mediators associated with inflammation (Cerejeira et al 2010:738). This causes the blood-brain barrier to disrupt and endothelial damage to occur (Cerejeira et al 2010:738). The brain is now susceptible to neuronal injury due to neuro-inflammation and the activation of microglia which can be linked to delirium development due to neurotransmitters inference (Cerejeira et al 2010:738).

With acute systematic inflammatory response activation, the neuro-inflammatory pathway causes changes in the brain parenchymal cells including the microglia cells, astrocytes and neurons. These changes are associated with acute onset of cognitive, behavioral and emotional changes (Cerejeira et al 2010:738). Acute systemic inflammatory response will be activated by infection, tissue destruction, hypotention, hypoxia, pain, blood loss, anaesthetics and drugs (Cerejeira et al 2012:670). This causes the production and release of pro-inflammatory cytokines into the bloodstream, activation of the inflammatory cascade and recruitment of the immune cells (Cerejeira et al 2012:670).

Protective immunity depends on the balance between pro- and anti-inflammatory responses to result in cell repair of damaged tissue or to fight infection without loss of organ function (Cerejeira et al 2012:670). Counteraction is activated to inhibit the systemic inflammatory process and consists of anti-inflammatory cytokines like interleukin, stress hormones, tissue necrotic factors that are called mediators. This mediator signals the central nervous system to release Acetylcholine by vagus nerve stimulation which interacts at the Nicotine acetylcholine receptors in immune cells (Cerejeira et al 2012:670). Disruption of balance results in increased secretion of pro-inflammatory cytokines into the bloodstream that trigger the neuro-inflammatory reaction, which affects the synaptic and neuronal function due to the neurotoxic effect of

cytokines secreted by the microglial and astrocyte cells and correlating with cognitive and behavioural changes seen with delirium (Cerejeira et al 2012:670).

Dysfunction of cortical areas and sub-cortical structures results in reduced reaction to stimuli (Cerejeira et al 2012:670). This could be the explanation for decreased cognitive function and high inflammatory markers observed in delirium (Cerejeira et al 2012:670). This effect can be worse in elderly and dementia patients because the neuro-inflammatory response would be greater due to abnormal microglia, increased pro-inflammatory mediator production and decreased level of protective mechanisms (Cerejeira et al 2012:670). Systemic inflammatory response disease causes deregulation in neuro-inflammation and can aggravate the pre-existing neuro degeneration and cognitive decline (Cerejeira et al 2012:670). The neuro-inflammatory pathway can be the major process underlying delirium in patients where they are exposed to acute systemic inflammatory conditions like infection and surgery (Cerejeira et al 2012:670). Patients who arouse out of a coma can also have delirium that will indicate a fluctuation of mental state and these comatose patients usually develop delirium before they recover to baseline mental function (Ely 2002:5).

2.6 RISK FACTORS FOR DELIRIUM

It is essential to identify vulnerable patients pre-operatively with non-modifiable causes for delirium because they have a higher risk to develop delirium while decreased exposure to modifiable causes for delirium can limit delirium incidence (Hsieh, Shum, Lee, Hasselmark et al 2015:496; Vasilevskis et al 2012:287). Vulnerable patients can develop delirium with a simple urinary tract infection where non-vulnerable patients (no dementia and high functional status) can develop delirium with noxious stimuli like severe sepsis (Vasilevskis et al 2012:283)**.** Table 2.2 and 2.3 lists the modifiable and non-modifiable causes of hypoactive delirium and delirium. Modifiable causes will be discussed which is causes that can be reversed by treatment.

Table 2.2 Modifiable causes of all types of delirium

Modifiable causes of all types of delirium
• Direct brain insult and environmental factors • Metabolic changes, hypoglycaemia, direct injury to brain, hypoxia and drugs (MacLullich, Ferguson & Cunningham 2008:232)
• Alcohol withdrawal syndrome (Awassi, Lebrun, Coursin et al 2013:22). • Nicotine withdrawal syndrome: Hsieh et al (2013:502; Honisett 2001:321; Awassi et al 2013:58) • Sedation and opioid withdrawal: symptoms are non-specific agitation, anxiety, irritability, restlessness, sleep disturbances, hallucinations; vomiting and diarrhoea; and tachycardia, tachypnea, sweating, and fever but the Pain, anxiety and delirium management guidelines say that sedation and opioids administered over longer periods should be weaned over several days to prevent withdrawal (Barr, Kishman & Roman 2013:9).
• Opioid and sedation usage: the prognosis of sedation related delirium is better than hypoactive delirium (Patel, Poston, Pohlman, Hall, et al 2014:1443). Opioid and sedation medication can increase delirium in ICU because it alters mental status (Patel et al 2014:1443) and should be adjusted daily (Awassi et al 2013:59) and sedation vacation withdrawal symptoms can appear (Awassi et al 2013:59). Sedation should be stopped for more than 2 hours before delirium assessment is done (Patel et al 2014:1443).
• Chemical and physical restraints: Invasive lines were identified to increase delirium and a potential modifiable risk factor (Sullah et al 2010:210).). Physical restraints were shown to increase delirium prevalence (Mehta, Cook, Devlin, Skrobik et al 2015:565; McPherson et al 2013:408) and restraining lines, devices like intra-aortic balloon bump and ventricular assist devices that inhibit mobilization especially cardio-thoracic patients with catheters (McPherson et al 2013:408).

Modifiable causes of all types of delirium
• Intensive care environment: The prevalence of delirium is higher in multi rooms than single rooms in the ICU (Zaal, Spruyt, Peelen & Van Eijk). • 2013:481; Curaso, Guardian, Tiengo et al 2014:2204) and modifiable causes of delirium in the environment include sedation, immobilization, pain, disorientation and sleep deprivation and non-pharmacological interventions should limit this (Hsieh et al 2013:497).
• Post-operative delirium: Stress response due to surgery anaesthesia, inadequate brain perfusion, hypoxia, hypoglycaemia, electrolyte, disturbances, volume depletion, infection, drug interactions and neurotransmitters can increase post-operative delirium (Flinn, Diehl, Seyfried & Malani 2009:268).

In table 2.3 the non-modifiable causes will be discussed, this is causes that cannot be changed.

Table 2.3 Non- Modifiable causes of all types of delirium will be discussed in this table

Non-modifiable causes of all types delirium
• Aberrant stress response: Harmful stress response on the brain which enhances symptoms like old age, pre-existing brain pathology like dementia (MacLullich et al 2008:232) • Mechanical ventilation and metabolic acidosis (Zaal et al 2015:45) • Advanced age > 65 years increases risk for delirium, 80 years and older have 35% prevalence for delirium, especially with prior cognitive impairment (Hsieh et al 2013:496; Zaal, Devlin, Peelen & Slooter 2015:235; Vasilevskis et al 2012:287; Ryan et al 2015:7) • History of dementia (Hsieh et al 2013:496;Devlin et al 2015:45) • Co-morbidities: Hypertention, poly-trauma and emergency surgery (Hsieh et al 2013:496) • Poor health (Vasilevskis et al 2012:287) • Multi-organ failure (Vasilevskis et al 2012:287; Sanjay, 2014:164) • One recent surgery (Vasilevskis et al 2012:28)

Non-modifiable causes of all types delirium
• Impaired cognition, depressive symptoms, history of cerebral-vascular incident or trans- ischemic attack (TIA) and abnormal albumin levels (Rudolph et al 2009:229-236)..
• Cognitive decline is a very strong non modifiable risk for post-cardio thoracic surgery due to inhabitation of cerebral cholinergic activity in patients with cognitive impairment causing them to be more vulnerable (Kazmierski et al 2010:5)
• History of cerebrovascular incidence (Shadvar et al 2013:160; Banach, Mariscalco, Vyalucan, Mikhailidis et al 2008:1267; Rudolph et al 2009:229-236; Chang et al 2008: 570).
• Historyof dementia (Chang et al 2008:570; Norkiene et al 2013:2; Ahmed, Leurent & Sampson 2014:326)
• History of renal diseases and increased urea and creatinin levels (Chang et al 2008:570; Ahmed et al 2014:326)
• Low or high sodium levels in blood (Ahmed et al 2014:326)
• Prolonged hospital stay (Ahmed et al 2014:326; Svenningsen, Egerod, Videbech et al 2013:29
• Poor ADL liver function (Ahmed et al 2014:326)
• Urine retention (Ahmed et al 2014:326)
• Poly-pharmacy (Ahmed et al 2014:326)
• Co-morbidity disease history and illness severity measured by APACHEII score
• (Ahmed et al 2014:326)
• Left ventricular ejection fraction of less than 30% (Chang et al 2008: 570)
• Atrial fibrillation (Shadvar et al 2013:160; Kazmierski et al 2010:5; Banach et al 2008:1267;
• Norkiene, Ringaitiene, Misiurience et al 2007:184; Chang et al 2008:570)
• Pre-operative atrial fibrillation is the strongest non-psychiatric predictor of post-operative
• delirium with six- fold increase (Banach et al 2008:1267)
• Age (Shadvar et al 2010:161) Age > 65 years (Norkiene et al 2007:184)
• Diabetes (Shadvar et al 2010:161; Norkiene et al 2007:184)
• Hypertension (Shadvar et al 2010:161; Norkiene et al 2007:18)

Risk factors for delirium in intensive care patients must be identified beforehand to ensure early detection and treatment of delirium after admission or post-operatively (Shadvar, Baastani, Mahmoodpoor & Bilehjani 2013:158). Modifiable risk factors must be limited by non-pharmacological and pharmacological interventions and non-

modifiable risk factors should be known beforehand to be treated early for delirium prevention (Rivosecchi, Smithburger, Svec, Campbell et al 2015:47).

With surgical patients, the risk for delirium can be limited due to less surgical techniques, decreased surgical duration, avoiding blood transfusion if possible, avoiding Benzodiazepine use as sedation (Vasilevskis 2012:283). Sullah (2010:210) state that invasive lines and Midazolam sedation contribute to delirium incidence and are a modifiable risk factor that should be addressed. Polypharmacy (6 or more drugs a day) in elderly patients is an independent risk factor for the occurrence of delirium after emergency admission (Hein, Forgues, Piau et al 2014:850). Sleep deprivation can lead to delirium and psychosis, and preoperative increased inflammatory markers can increase risk for delirium (Cunningham et al 2013:6). Prior cognitive impairment is the biggest risk indicator for delirium (Cunningham et al 2013:6). Psychological stress leading to higher cortisol levels and direct insults to the brain due to hypoxia can lead to delirium (Cunningham et al 2013:10).

Post-operative delirium is commonly seen, it is under diagnosed in patients and is potential preventable, but underdiagnosed is associated with higher mortality and result in longer hospital stay (Whitlock, Vannucci & Avidan 2011:448). Delirium occurs post-operatively in up to 87% of all patients and usually between one to three days post procedure or anaesthesia and depends on the age of the patient, the type of surgery, and the type of anaesthesia used (Whitlock et al 2011:448). Cardiac surgery has the highest risk for delirium incidence of 51% of all surgery patients according to Ferri 2015:356; Vasilevskis et al 2012:279 but McPherson 2013:406 state that 64% of all ICU patients developed delirium and 8% died within 28 days

A cardiac pulmonary bypass procedure increases the risk for post-operative delirium due to sclerotic emboli which are dislodged after canalizing of the ascending aorta during cardio pulmonary bypass pump (Shadvar et al 2013:160; Chang, Tsai, Liu et al 2008:570). Excursion of Mean arterial blood pressure above the upper limit of cerebral auto regulation (55-75mmHg) during cardio pulmonary bypass (CPB) is associated with

increased risk for delirium and optimizing Mean arterial blood pressure during CPB within cerebral auto regulation range might reduce delirium (Hori, Brown, Ono, Rappold, et al 2014:1012).**.** A prior history of stroke and TIA; depression; abnormal albumin, and mini mental examination score are four risk factors for delirium (Rudolph, Jones, Levkoff, Rockett et al 2009:235). Most ICU patients need sedation, analgesia, opioids, benzodiazepine, hypnotics, and antipsychotics to facilitate ventilation that can lead to respiratory depression, hypotension, renal failure and deconditioning with risk increased of delirium with Benzodiazepine treatment (Balas, Vasilevskis, Burke et al 2012:36). Maintaining a light level of sedation but good analgesia, the clinical outcomes of ICU is better (Barr & Pandharipande 2013:109).

The duration of mechanical ventilation due to poor respiratory condition is linked to increased incidence of delirium (Shadvar et al 2013:158; Norkiene, Ringaitiene, Kuzminskaite & Sipylaite 2013:2; Kazmierski, Kowman, Banch, Fendler et al 2010:179). The shorter the duration of ventilation, the less complications could appear and minimization of delirium prevalence (Zaal et al 2015:45). Mechanically ventilated patients usually receive more sedation, muscle relaxants and anaesthesia that could influence their brain function (Kazmierski et al 2010:180). Table 2.3 indicates the pre- and post-operative modifiable and non-modifiable risk factors for delirium.

In table 2.4 below modifiable risk factors of all types of delirium are discussed which can lead to delirium post-operatively and should be addressed in the ICU to limit delirium incidence. Table 2.4 follows modifiable risk factors for all types of delirium post-operatively.

Table 2.4 Modifiable risk factors for all types of delirium post-operatively

Cognitive disorders history (Rudolph et al 2009:229; Chang et al 2008: 570)

- 23% increase in delirium incidence with 60 years and older patients, longer mechanical ventilated patients and cardio-pulmonary bypass machine (Reissmuller, Aguero & Vander 2007:176).
- Intra-aortic balloon pump (Norkiene et al 2007:184)
- Emergency cardiac bypass (Norkiene et al 2007:184; Chang et al 2008:570)
- Antidepressant usage before cardio thoracic surgery increase risk for delirium (Hori et al 2014:1012) and episodes of mayor depressive disorder (Kazmierski et al. 2010:5
  Rudolph et al 2009:253)
- Mechanical ventilation more than 48 hours (Hori et al 2014:1012)
- Post-operative hypoxia (Kazmierski et al 2010:5)
- Prior history of cerebrovascular incidence and congestive heart failure increase risk for delirium post-operative cardio-thoracic surgery (Hori et al 2014:1012).
- Cardiogenic shock (Chang et al 2008: 570) and metabolic acidosis (Chang et al 2008:570; Norkiene et al 2013:2)
- Peripheral vascular disease risk for arteriosclerosis (Noriene et al 2007:184; Rudolph et al 2009:229-236)
- Anaemia (Chang et al 2007:570; Norkiene et al 2013:2; Kazmierski et al 2010:5),
- blood transfusions are an independent predictor of post-operative delirium, because of transient ischemia (Chang et al 2007:570; Norkiene et al 2013:2).
- Low albumin levels associated with frailty, poor nutrition and functional abilities with intravascular volume status and drug binding (Ahmed et al 2014:326; Rudolph et al 2009:229-236)
- Fluctuation in sedation levels may cause delirium (Svenningsen et al. 2013:292)
  Intra-operative hemofiltration (Norkiene et al 2007:184)
- Complicated surgery that takes longer to perform can be linked to post-operative delirium and longer mechanical ventilation (Norkiene et al 2013:5
  Intra-operative factors like complex surgery, circulatory arrest for 30 minutes, blood transfusion more than 1 litre, body temperature lower than 25 degrees Celsius can result in post-operative delirium (Chang et al 2008: 570).

Modifiable causes of all types of delirium post-operatively
• Atrial fibrillation, treatment of atrial fibrillation after cardiac surgery can limit the incidence of delirium post-operative due to cerebral emboli hypo-perfusion and arterial hypotension (Kazmierski et al 2010:5; Shadvar et al 2010:161; Chang et al 2008:570) • Blood transfusion, blood loss more than 1 litre, haematocrit lower than 30%, cardiogenic shock (Chang et al 2008:570) • Reoperation (Chang et al 2008:570) ,anaemia increase risk by 4 times after cardiac surgery (Kazmierski et al. 2010:5) • Low albumin (Chang et al 2008:570) • Renal insufficiency with increased creatinin levels (Chang et al 2008: 570). • Hepatic dysfunction with increase total bilirubin levels (Chang et al 2008: 570). • Hypercarbia with pCo2 more than 45mmHg (Chang et al 2008: 570). • Anticholinergic medication (Chang et al 2008: 570). • Independent post-operative risk factors that cause delirium by 41%, were low albumin levels, low haematocrit <30%, post-operative cardiogenic shock with inotropic use and post-operative infection (Chang et al 2008: 570). • Antidepressant usage before cardio thoracic surgery increase risk for delirium (Hori et al 2014:1012). • Duration of ventilation and duration of ICU stay independent risk factors for post-operative delirium is (Norkiene' et al. 2013:2). • Off pump cardio artery bypass can decrease the risk for delirium due to decreased risk of emboli dislodgement from the bypass machine canalization (Hernandez, et al. 2007:1901). • Use of vasopressors increase risk of delirium (Kanova et al 2017:192). • Artificial ventilation patients can increase delirium and duration of ventilation can increase due to delirium (Kanova et al 2017:192) • Alcohol abuse, use of sedatives, trauma admission and age >65 years are strongest predictors (Kanova et al 2017:192)   • Preoperative cognitive decline (Kazmierski et al. 2010:5) Old Age (Kazmierski et al. 2010:5).

2.7 COMPLICATIONS OF HYPOACTIVE DELIRIUM AND DELIRIUM

Complications of hypoactive delirium and delirium result in increased length of ICU stay, which result in longer time for development of delirium due to more sedation used (Rivosecchi et al 2015:50; Ely 2002:2; Mehta et al 2015:565; Ahmed et al 21014:6). Length of stay can also be associated with comorbidities like dementia (Ahmed 2014:6); increased hospital cost and risk for developing hospital acquired infection (Rivosecchi et al 2015:50; Ely 2002:5); increased mortality (Rivosecchi et al 2015:50; Ely 2002:5) and cognitive impairment (McPherson et al 2013:7). Mortality is linked directly to duration of delirium where the duration of delirium in ICU patients is one of the strongest indicators of death (Ely 2002:2, 5; Salluh et al 2010:210).Length of stay, cost of care and long-term cognitive impairment and the need for re-intubation or discharge to a long-term facility are complications of delirium as well (Ely 2002:2, 5; Salluh et al 2010:210). There is a close relationship between disease severity and the risk of delirium development (Kanova, Sklienka, Kula, Burda & Janoutova 2017:192).

2.8 SIGNIFICANCE OF HYPOACTIVE DELIRIUM AND DELIRIUM DETECTION

Early recognition is the key to delirium prevention by using validated delirium screening tools (McPherson et al 2013:7; Hori et al. 2014:1012) and should be standardized about timing of assessment with sedation interruption (Patel et al 2014:662). Delirium mainly goes unnoticed by ICU staff due to lack of education on the fluctuation nature of delirium and the ability to present clinically similar to other conditions (Svenningsen et al. 2013:292). Continuous education is needed related to delirium identification in ICU patients (Speed 2015:94). The implementation of delirium screening incorporation into daily nursing practice is achievable and sustainable and can be maintained by continuous education to critical care nurses (Scott, McIlveney & Mallice 2013:101). Post-operative delirium in cardiac surgery patients is independently associated with increased length of stay in ICU (Brown, Laflam, Max et al 2016:5).

Hypoactive delirium and delirium is the independent predictor of 6 months' mortality and long-term cognitive impairment and the longer patients experience delirium, the higher the mortality (Ely, Shintani, Truman et al 2004:1753; Salluh et al 2010:210). Delirium is directly connected with poor health outcomes and the longer the delirium, the worse the outcome for basic daily motor and sensory function and not just higher mortality and cognitive decline(Ely et al 2004:1753; Salluh et al 2010:210). These patients will need assistance in basic activities of living and will not be able to function independently anymore (Brummel, Jackson, Pandharipande, Thompson et al 2014:2).

Sedation interruption/vacation should be done for at least 2 hours or more before patients are screened for delirium using the CAM ICU tool, because patients must have an RASS score of 0 and greater to be screened for hypoactive delirium (Patel et al 2014:663). If sedation vacation is done, the chances are that patients will be more awake and not have an RASS score of -2 and -3 that could not be assessed for delirium using the CAM ICU tool or ICDSC (Brummel et al 2013:2199). Sedation-induced delirium is less dangerous than other causes of delirium because the latter patients are sicker, ventilated longer, have a longer ICU stay and higher mortality rate for 1 year (Patel et al 2014:663). Rapid reversible sedation-related delirium has a better prognosis than hypoactive delirium and the degree of delirium should be assessed with the use of a screening tool used as daily assessment in ICU (Patel et al 2014:662). Sedation interruption is recommended to prevent over sedation, but is usually done during the day, but delirium can occur during the night as well, so delirium can be missed if not monitored 24 hours a day (Svenningsen et al 2013:292). Fluctuation in sedation levels is one of the causes of the onset of delirium and sufficient analgesia is important or no sedation at all (Svenningsen et al 2013:292).

Pain and sedation algorithms were formulated to prevent over-sedation and decrease pain (Barr, Kishman & Roman 2013:10). Early identification and treatment of delirium is important to improve better health outcomes (Zaal & Slooter 2012:1457). The pain, agitation and delirium (PAD) guidelines, 2013 assist healthcare professionals to

manage these patients effectively and implementation needs a multi-disciplinary approach, coordination and cooperation (Balas et al 2013:117).

2.9 MANAGEMENT OF HYPOACTIVE DELIRIUM AND DELIRIUM

Preoperative screening before cardiac surgery is important to identify cognitive impairment, major depression, medical illnesses such as anaemia, and atrial fibrillation because it is a non-modifiable risk factor for delirium occurrence post-cardiac surgery (Kazmierski et al 2010:6). If atrial fibrilliation is present, patients need to be treated pre-operatively to reduce the risk for post-operative delirium. Oxygen and carbon dioxide levels should be checked post-operatively and the duration of mechanical ventilation should be limited (Kazmierski et al 2010:5).

Reorientation, minimization of sedation levels, decreased mechanical ventilation and the use of Dexmetomidine are effective to minimize delirium (Zaal et al 2015:45). Delirium screening is essential and all patients should be assessed for arousal using the Richmond agitation score (RASS score) and content using the confusion assessment method for ICU (CAM ICU) tool or intensive care delirium screen checklist (ICDSC) (Brummel et al 2013:2199; Bergeron et al 2001:862; Ouimet et al 2007:1007-1013). Patients can only be assessed with the CAM ICU/ICDSC tool if the RASS score is more than -3 where a patient is arousable to voice and not comatose, then the patient cannot be assessed for delirium (Brummel et al 2013:2199).

2.9.1 Non-pharmacological management (interventions)

Change in sedation protocols can improve brain dysfunction and delirium assessment tools should be promoted and adopted in ICU setting (Hughes, Brummel, Vasilevskis et al 2012:402) In order to limit the incidence of hypoactive delirium and delirium, prevention is important and this can be done by implementing non-pharmacological nursing interventions. Non- pharmacological interventions consist of three aspects, namely improving communication between ICU team members; standardizing delirium

care prevention, and limiting as well as breaking the cycle of over-sedation and prolonged mechanical ventilation that may lead to delirium (Balas et al 2012:45). Implementation of strategies to decrease the exposure of sedation is necessary to limit delirium risk (Balas 2012:36). Nurses play a very important role in the implementation of delirium prevention bundles where delirium/agitation is monitored and sedation vacation is implemented (Balas et al 2012:36). Nurse led assessment of these patients is detrimental for weaning off sedation of a ICU patient, for early mobilization, implementation of sedation vacation and extubation of a ICU patient that will decrease ventilator days and risk for delirium (Balas 2012:46; Hughes et al 2012:402).

2.9.1.1 Reorientation and cognitive stimulation

Prevention and treatment of risk factors such as cognitive stimulation and reorientation have the greatest benefit in minimizing delirium and multi-component non-pharmacological interventions have a greater benefit over only one intervention and should be practised (Rivosecchi et al 2015:47; Atalan et al 2013:936). These non-pharmacological interventions should include early mobilization, cognitive stimulation with reorientation and education of nurses (Rivosecchi et al 2015:47; Atalan et al 2013:936). Continued automated reorientation intervention by means of recordings played for patients was found to have a benefit in delirium reduction in ICU ventilated patients. Patients whose families made the recordings developed less delirium than an unknown voice talking in the recording (Munro Cairns, Ming, Calero, McDowell et al 2017:5). Cognitive stimulation with reorientation means that nurses can orientate the patient in any form they choose but includes knowing how the patient wants to be addressed; frequently repeating the date and time; giving the patient updates about their clinical status and programme for the day, and talking to a patient that requires memory recall by the patient (Rivosecchi et al 2015:47). Atalan et al (2013:936) emphasise the repetitive provision of cognitive stimulation activities, sleep protocols, maintenance of day and night sleep, range of motion exercises with early mobilization, reduction of physical restraints and removal of invasive devices. Reorientation hourly by the use of familiar voice recordings can be helpful (Munro et al 2017:5).

Mistraletti et al (2012:321) list the following non-pharmacological interventions that may assist the patient with reorientation: Involve family with neurological monitoring; have a specific handover meeting about delirium prevention; train staff about validated tools; continuous visual and auditory media used at home to be used in hospital; have wall clocks, watches and calendars visible; call patient by name; place pictures of family in the room; turn patients' beds so they can orientate about daylight/darkness; schedule informational interviews with ICU staff about diagnostic and therapeutic measures, and allow newspaper reading.

2.9.1.2 Mobilization

Early mobilization, noise reduction and sleep protocols have a benefit in reducing delirium (Rivosecchi et al 2015:47). Mobilization can be full mobilization or passive movements and nurses must advocate early removal of intravenous lines and catheters that inhibit mobilization (Rivosecchi et al 2015:47; Mistraletti et al 2012:321). Education of nurses is very important if new strategies are to be implemented for delirium prevention, because resistance to change can be a problem. Resistance can be minimized, however, by teaching nurses about how severe delirium can impact a patient's life and recovery and what the impact of delirium will be on the patient if it develops (Rivosecchi et al 2015:47). Mobilization to limit falls and delirium is necessary (Hsieh, Yue, Oh, Puelle, et al 2015:516-519).

2.9.1.3 Visual and hearing aids

Patients must use their glasses and hearing aids and nurses should focus on early correction of dehydration, use of pain medication, placing familiar objects around the bed, clocks where patients can see them, calendars in the room, minimize noise and stimuli (Atalan et al 2013:936).

2.9.1.4 Sedation, pain management and sleep hygiene

The pain, agitation and delirium guidelines were formulated to improve the management of pain, agitation and delirium (PAD) (Barr & Pandharipande 2013:109). Implementation of the guidelines gives ICU nurses the opportunity to nurse ICU patients with humanity

and improve their life expectancy after discharge (Barr & Pandharipande 2013:109). Changing sedation levels are associated with delirium and a stable sedation level or non-sedation is recommended to limit the incidence of delirium (Svenningsen et al 2013:292).Sedation and analgesia make delirium worse (Balas et al 2012:36). Sedation and analgesia are important in ICU treatment to assure better mechanical ventilation, improve tolerance of invasive procedures and prevent patients from agitation and aggressive relationships by using benzodiazepine (Balas et al 2012:36; Sullah et al 2010:210). Sedation and pain-directed protocols and sedation vacation/spontaneous awakening trials (SATs) are now used to prevent over-sedation (Balas et al 2012:37). Difficulty of sleep can be addressed by Dexmedetomidine and result in a two-day shorter duration of delirium in ICU patients (Zhang et al 2015:83; Schweickert, Pohlman, Nigos et al 2009:1874-1882).

Sleeping in the ICU with earplugs resulted in fewer patients developing delirium or confusion and the onset of cognitive disturbance was delayed compared to patients not sleeping with earplugs (Van Rompaey, Elseviers, Van Drom, Fromont & Jorens 2012:9). Patients in the control group (who did not receive earplugs) developed delirium earlier than the intervention group (who received earplugs) (Van Rompaey et al 2012:9). More patients recorded better sleep if they used earplugs and the effect seemed to be the strongest within 48 hours after admission (Van Rompaey et al 2012:9). The use of earplugs, eye masks, tranquil music, relaxation techniques and back massages was found to have a significant improvement in cognitive impairment, perceived noise ratings and improved sleep which resulted in lower delirium scores (Kamdar, Kamdar & Needham 2014:528). Mistraletti et al 2012:321 maintain that nocturnal sleep should be promoted in ICU patients, daytime sleep discouraged and supplemented with melatonin. Sleep deprivation is associated with delirium incidence but the cause-and-effect are not clear and the use of sedation medication changes the sleep pattern and decreases rapid eye movement (REM) sleep (Watson, Ceriana & Fanfulla 2012:363).

2.9.1.5 Post-operative delirium

In a study in China, Zhang et al (2015:83) found that if risk factors were to be identified, post-operative delirium could be reduced after coronary artery bypass graft surgery by the nursing interventions of assessing and managing pain, early catheter removal, more family visits, reorientation, less care-related interruptions, optimizing comfort, and monitoring sleeping difficulties. Furthermore, Zhang et al (2015:83) implemented a nursing intervention programme that targeted risk factors post-operatively to reduce the incidence of delirium. The interventions included assessing the patients' pain five times a day, removing catheters and endotracheal tubes as early as possible, and orientation of five points, namely who is the nurse looking after the patient, where the patient is, what is the date and time, the routine in the unit, why and what the patient should do (Zhang et al 2015:83). Visiting time was increased with 30 minutes twice a day and family members were asked to re-orientate the patient during visiting time, play cognitive games and assist with early activities like eating (Zhang et al 2015:83). Less care related interruptions were found to be important including appropriate lighting, noise reduction, clustering night-time activities so that the patients may sleep 23:00-5:00, optimizing comfort with adequate room temperature, bathing at 20:00 and not 14:00 and the changing mattresses to inflatable mattresses to improve sleep and lessen discomfort (Zhang et al 2015:83). Cardiac surgical patients commonly experience post-operative delirium which results in increased mortality, morbidity, and a higher prevalence of sternum instability and prolonged ICU stay (Trabold & Metterlein 2014:17). Early detection is necessary and hypoactive delirium and delirium is frequently missed (Trabold, Metterlein 2014:17).

2.9.1.6 Pleasant ICU environment

In a study with ICU patients with similar baseline data, Tover, Suarez, Munoz et al (2016:64) conducted pre-tests (RASS and CAM ICU) and gathered patients' perceptions of environmental precipitating factors. Then nursing care based on Betty Neumann's theory was implemented for five days, after which the post-test was done (Tover et al 2016:68-71). Interventions were implemented for five days, including reduction of noise and other nursing care (Tover et al 2016:68-71). Implementation of

Betty Neumann's theory and evidence-based nursing might prevent delirium in 97% of cases. Maintaining a pleasant environment was found to lower delirium (Tover et al 2016:72).

2.9.1.7 Hydration, decreasing risk of falling, institutionalization, anaemia, dehydration, de-saturation

Non-pharmacological interventions are effective in decreasing hypoactive delirium and delirium and the prevention of falls for ICU patients and include investigation of cognition or orientation, early mobilization, hearing, sleep-wake cycle, vision and hydration (Hsieh et al 2015:516-519). Pre-operative anaemia, dehydration and signs of malnutrition have been associated with post-operative delirium and should be identified pre-operatively (Trabold & Metterlein 2014:17). Oxygen delivery to the brain is critical and cerebral oximetery is used in cardiac surgery patients while on the bypass machine and de-saturation can be associated with adverse outcomes which could result in delirium (Vretzakis, Georgopolou, Stamoulis et al 2014:67)

2.9.1.8 Vital observations

Vital observations necessary to prevent delirium include correcting hypoxia, improving hypo/hypertension, correcting anaemia and cardiac arrhythmias which can lead to organ failure (Mistraletti et al 2012:321). Further observations include adequate enteral hydration, encouraging adequate calorie intake, trace elements and vitamins intake, using dentures if necessary, facilitating intestinal bowel movement, avoiding unnecessary drug treatments especially neuro-active drugs, providing deep vein thrombosis prophylaxis, physical restraints only if necessary, and maintaining a normal pH balance (Mistraletti et al 2012:321). Table 2.5 summarises non-pharmocological intervention studies.

Table 2.5 Summary of non-pharmacological intervention studies

REFERENCE	POPULATION	INTERVENTION	OUTCOME	RECOMMENDATIONS
Abraha, Trotta, Rimland, Cruz-Jentoft et al 2015:13	Systematic review	• staff education • orientation programme • prevention of sensory deprivation • Multi- disciplinary approach • sleep protocol • early mobilization • hydration • nutrition • drug list review • oxygen delivery • regular bowel and bladder function • prevent and treatment of post-operative complications • environmental stimuli • delirium prevention • detection and treatment • treatment of agitated patient • individual care planning • prevention of falls	Non-pharmacological interventions very necessary	• staff education • early rehabilitation • clock and calendar in the room • avoidance of sensory deprivement with glasses, dentures and hearing aids • familiar objects in room, reorientation • extended visiting time • sleep deprivation • immobility • cognitive impairment • dehydration • drug use and daily monitoring

REFERENCE	POPULATION	INTERVENTION	OUTCOME	RECOMMENDATIONS
Goulart, Tonietto, da Silva, Daiana, Gutierres et al 2017:1	268 patients	• extended visiting hours133 minutes to 245 minutes	Extend visiting hours	Extended visiting hours was linked to a reduction in delirium and a shorter length of delirium/coma in ICU stay
Smith, Grami 2017:23-26	447 patients	Implemented delirium prevention bundle: sedation cessation, pain management, sensory stimulation, early mobilization, sleep promotion.	Patients who received delirium prevention bundle, experienced 78% less delirium	Delirium prevention bundle is feasible and effective to prevent delirium under medical-surgical ICU patients.
Zhang, Wu,Gu, Liu, Qiu, Ye et al 2015:83	141 intervention group, 137 control group	• Assess & manage pain • early catheter removal • more family visits • reorientation hourly • less care-related interruptions • optimizing comfort • monitoring sleeping difficulties	Post-operative delirium was reduced after coronary artery bypass graft surgery in the intervention group	Changes in best practice which is evidence-based in recognition and avoidance or minimization of risk factors may prevent delirium development
Munro, Cairns, Ming, Calero, McDowell, Anderson et al 2016:5)	30 patients were randomized	10 patients received hourly recording messages in a family member's voice during waking hours over and 10 patients received the same but in an unfamiliar voice	The group of patients that received the voice of a family member had more delirium-free days.	Automated reorientation intervention is a simple but powerful strategy to provide structured information continuously to patients and is easy and cheap

REFERENCE	POPULATION	INTERVENTION	OUTCOME	RECOMMENDATIONS
Flannery, Oyler & Weinhouse 2016:2231-2240	Systematic review of 10 studies	Improving of sleep in an ICU and reduction of ICU delirium by use of pharmacological and non-pharmacological interventions	Reduction in ICU delirium associated with sleep intervention, Shorter duration of delirium with sleep interventions and sleep intervention with reduction of ICU length of stay	Conclusion is limited due to bias, varying methodologies and multiple other Determinants
Schweickert , Pohlman, Nigos, Pawlik, et al 2009: 1874-82	104 patients	104 hemodynamically stable patients were evaluated for the effect of daily sedation interruption paired with occupational and physical therapy with long term functional independence and the effect on delirium.	The intervention group had a 2-day shorter delirium median and both groups had similar sedation	Physical therapy with passive or active exercises is recommended
Hayhurst, Pandharipande & Hughes. 2016:1235	Systematic review	Fragmented sleep is associated with delirium and sleep habits must be improved by creating a pleasant ICU environment and patients using earplugs	Sleep hygiene was implemented with earplugs	Reduction of delirium due to better sleep habits and is recommended

REFERENCE	POPULATION	INTERVENTION	OUTCOME	RECOMMENDATIONS
Tover, Omara, Suarez, Munoz 2016:68-71	49 patients	Pre-test (RASS and CAM ICU) and post-test was done. For 5 days. Interventions were: reduction of noise, continuous artificial lighting which cause impaired sleep in 84%.	94% delirium was prevented in this study	Implementation of Betty Neumann's theory and evidence based nursing might prevent delirium in 97% of cases. Maintaining a pleasant environment was proven to lower delirium
Smith, Grami. 2017:24	447 patients were screened with CAM ICU for delirium and a delirium care bundle was implemented	Effectiveness and feasibility of a delirium prevention bundle in critical ill patient.	• Sedation vacation. • Pain management • Sensory stimulation. • Early mobilization. • Sleep promotion	• Consistent practice of daily flow of nursing care in the delirium prevention bundle is critical to reduce delirium incidence. • 78% delirium reduction if delirium prevention bundle is implemented on patients. • Mechanically ventilated patients have a 3 times higher risk developing delirium. • Physical restraints increase the change for delirium 2.82 times. • Patients who stay longer than 3 days in ICU have a 3 times more likely to develop delirium. • Early mobilization • Sleep hygiene • Pain management

2.10 NURSES' ROLE IN SUCCESSFUL IMPLEMENTATION OF HYPOACTIVE DELIRIUM AND DELIRIUM PREVENTION STRATEGIES/BUNDLES

Nurses usually complain about not having time to implement non-pharmacological interventions to limit delirium, but if the whole multi-disciplinary team has an input, then the outcome is better and the team focuses on what interventions will work for which patients and this will decrease the strain on nurses (Rivosecchi et al 2015:47). Nurses have the greatest influence over a successful non-pharmacological intervention plan implementation because they have the most patient contact (Rivosecchi et al 2015:47).

The ICU nurses' role in detecting delirium as part of their daily activities is difficult because delirium can present as similar conditions due to the fluctuating nature of the disease, and so it goes unnoticed, especially hypoactive delirium and delirium (Balas et al 2012:45). The ICU nurse can only detect delirium through continuous training about delirium that will result in increased identification of delirium (Speed 2015:94).Delirium prevention is better than treatment and the focus is on prevention of delirium (Speed 2015:94). Non-pharmacological interventions like early mobilization should be done in ICUs (Patel et al 2014:663). Patients should be screened for delirium at least once every 24 hours to identify delirium early and identify modifiable risk factors (Ahmed et al 2014:6.) Nurses should use a validated delirium screening tool to screen for delirium (Svenningsen et al 2013:292). All patients within all the subtypes of delirium should receive reorientation to improve delirium outcome (Grover et al 2014:290). Implementation of nurse-led preventive protocols/bundles is critical for successful implementation, because nurses can provide critical insight into the problem of delirium and are at the bedside to assess the patient continuously for delirium (Speed 2015:94; Balas et al 2012:45).

Successful implementation requires high quality, on time and reliable staff to implement the delirium care bundle and good communication between nurses and members of multi-disciplinary team about steps and principles of delirium care bundle

implementation to assure consistency (Balas et al 2012:45; Mistraletti et al 2012:323). A nurse driven leadership is very important that will drive the implementation, ongoing support, and changes needed with the implementation of a delirium care bundle (Balas et al 2012:45). The development or prevention of delirium in ICU patients depends on the failure or success of integrated care driven by ICU nurse leaders (Balas et al 2012:45), because ICU nurses can change nursing regarding delirium detection by continuous focusing and teaching about delirium prevalence, presentation, risk factors identification and the use of screening tools Speed 2015:94).

When bundles are implemented to improve quality of care, prompt documentation is necessary to help with implementation and long-term sustainability (Carruthers, Barr, Spurlock, Ridgely et al 2013:135). Nurses are more likely to identify inattention and disorientation in the form of patients' strange and unusual communication and behaviour because of increased contract during nursing care (Ryan et al 2015:7)

2.11 THE DOCTOR'S ROLE IN SUCCESSFUL IMPLEMENTATION OF HYPOACTIVE DELIRIUM AND DELIRIUM PREVENTION STRATEGIES/BUNDLES

As part of the multi-disciplinary team, the doctor needs to address medications prescribed that can decrease the incidence of delirium. The use of Dexmedetomidine® and Propofol® for sedation is recommended rather than Benzodiazepine sedation that can reduce hospital stay and duration of mechanical ventilation (Fraser et al 2013:30). The use of medication as sedation, like Benzodiazepine, is more likely to cause delirium and other drugs like Amphetamine cause delirium with agitation (Cunningham, MacLullich 2013:8)**.** Light sedation of an ICU patient leads to better ICU clinical outcomes, given that the patient is comfortable and can be achieved by following bundles (Barr et al 2013:109)**.** Delirium monitoring and detection is very important for the ICU clinician, because the duration of delirium in ICU is independently associated with newly acquired disability and physical dysfunction during the first year after a critical illness so that patients are frequently unable to carry out basic activities of daily

life for independent living after delirium in ICU (Brummel et al 2014:8). Statin use preoperatively is linked to lower delirium incidence due to anti-inflammatory effects (Page, Ely, Gates et al 2013:670).

2.12 THE FAMILY'S ROLE IN SUCCESSFUL IMPLEMENTATION OF HYPOACTIVE DELIRIUM AND DELIRIUM PREVENTION STRATEGIES/BUNDLES

Patients' family members must bring objects from home like photographs, clocks, calendars, glasses, hearing aids, and familial objects to support the delirious patient (Mistraletti et al 2012:321).Visitng times can be extended and family can be educated to reorientate the patient during visiting time (Mistraletti et al 2012:321). Smith and Grami (2017:26) found that family members were reluctant to bring hearing and visual aids to ICU out of concern they would be lost or broken, so many patients could not use these aids.

2.13 VALIDATED INSTRUMENTS TO DETECT ALL SUBTYPES OF DELIRIUM IN ICU

Five adult delirium screening tools have been developed for the diagnosis of delirium, namely the intensive care delirium screening checklist (ICDSC), the confusion assessment method for intensive care unit (CAM ICU), the nursing delirium screening scale (Nu-DESC), the delirium detection score (DDS) and the cognitive test for delirium (CTD) (Brummel et al 2013.2199). The CAM ICU and ICDSC tools are the most widely identified and recommended for use (Brummel et al 2013:2199). The assessment of a patient's level of arousal should be done by using a validated reliable tool and the CAM ICU is one of the most reliable and valid tools (Ely 2002:2). The ICDSC checklist is also widely used because it can identify hypoactive delirium and delirium where the other checklists or scales can only detect delirium in totality (Bergeron et al 2001:862; Ouimet et al 2007:1007-1013).The Richmond agitation sedation scale (RASS) can be combined to assess the grey zones/stupor where a patient is between coma and

alertness (Babar, Khan, Guzman, Campbell et al 2012:48). This is when the patient is unable to be assessed if in a comatose state which is an inability to respond to verbal commands (Babar et al 2012:48). The RASS score will be -4 and -5 and the patient will not be assessed for delirium (Baba et al 2012:48). In this study, the ICDSC and RASS score were utilized because they are validated reliable scores (Ely 2002:2) and the RASS score is already in use every day in the specific ICU Gusmao-Flores, Salluh, Chalhub and Quarantini (2012:9) found that the CAM ICU tool is an excellent diagnostic tool while the ICDSC has moderate sensitivity and good specificity and both screening tools can be used to diagnose delirium in critically ill patients (see Annexure E for the bundles and screening tools).

2.13.1 Pain, Agitation and Delirium (PAD) care bundle

The PAD care bundle (Barr, Kishman & Roman 2013:9) detects pain first, and then the need for sedation and light sedation is advised. The bundle is used as a multi-disciplinary team-based approach to assess and manage pain, depth of sedation and delirium in ICU patients using pharmacological and non-pharmacological interventions for ventilated and non-ventilated patients. Sedation criteria are to avoid Benzodiazepine for delirious patients or at high risk for delirium. The PAD guidelines focus on spontaneous awakening trials and breathing trials and link them to early mobilization to reduce risk of delirium as well as on environmental changes about sleep-awake cycles to reduce delirium. The PAD care bundle recommends the use of non-pharmacological interventions to prevent delirium (Rivosecchi et al 2015:50).

2.13.2 Confusion Assessment method for ICU (CAM ICU tool)

The Confusion assessment method for ICU patients (Ely 2002:5) was created in 1990 and designed for non-delirium experts to diagnose delirium (Inouye et al 1990:941-948) (see Annexure K for CAM ICU tool). The CAM ICU tool assesses four features, namely: acute change of fluctuating course of mental state and inattention and altered level of consciousness or disorganized thinking (Ely et al 2001:2705). Delirium assessment

assesses consciousness, which can be divided in two parts, namely arousal level and content.

2.13.2.1 Feature 1: measures acute change or fluctuation course of mental state by assessing if there is a change in the baseline mental state (Admission mental state) or mental state change in the last 24 hours.

2.13.2.2 Feature 2: measures inattention by alertness of patients when they need to respond to a stimulus in their environment (Ely 2002:10; Ely et al 2001:2705).

2.13.2.3 Feature 3: uses the current RASS level to measure altered level of consciousness and disturbance and change in cognition.

2.13.2.4 Feature 4: Disorganized thinking will be assessed by asking simple questions and 2- step commands. T

2.13.3 Awakening, spontaneous breathing, coordination of awakening, choice of sedation, delirium screening and early mobilization (ABCDE bundle)

The ABCDE bundle assesses awakening trials to reduce use of sedation, spontaneous breathing trials to wean patients off mechanical ventilation quicker, coordination of awakening and breathing trials to maximize benefits, choice of the correct sedation, delirium screening and treatment and early mobilization to decrease ICU-related muscle weakness (Carruthers, Barr, Spurlock, Ridley et al 2013:128).Factors identified to facilitate and improve the implementation of this bundle included good and stable ICU leadership and multidisciplinary rounds; patient safety and quality improvement; establishing a culture in the unit before bundle implementation; an ICU clinical champion who provides effective and stable leadership, training and hands-on support, and rounding checklists (Carruthers et al 2013:134).Factors identified that hinder bundle implementation were excessive staff turnover; moral issues; lack of respect among multidisciplinary team members; excessive use of agency personnel and lack of resources for early mobilization (Carruthers et al 2013:134).

2.13.4 Intensive care delirium screening checklist (ICDSC)

The ICDSC is a screening tool formulated to detect hypoactive, hyperactive and mixed form delirium for intensive care patients (Bergeron et al 2001:862; Ouimet et al 2007:1007). Gusmao-Flores et al (2012:1-10) evaluated the current evidence on the accuracy of the ICDSC for the diagnosis of delirium in critically ill patients. The pooled sensitivity of the ICDSC was 74% (95% CI: 65.3 to 81.5%), and the pooled specificity was 81.9% (95% CI: 76.7 to 86.4%). The diagnostic odds ratio was 21.5 (95% CI: 8.51 to 54.4) and the AUC was 0.89. The ICDSC, therefore, has moderate sensitivity and good specificity and can be used as a screening tool for the diagnosis of delirium in critically ill patients. It can be used to screen the patient throughout the whole 24-hour nursing shift (Gusmao-Flores et al 2012:10). The ICDSC consists of eight questions (see Annexure C). Questions 1-4 needed bedside assessment of the patient; if the patient was deeply sedated or comatose (RASS -4 or -5), he/she could n0t be assessed. Questions 5-8 were observed throughout the whole shift. Information from the previous 24 hours was needed for questions 7 and 8.

The focus areas consist of the following:

- Altered level of consciousness
- Inattention
- Disorientation
- Hallucination, delusion, or psychosis
- Psychomotor agitation or retardation
- Inappropriate speech or mood
- Sleep-wake cycle disturbance
- Symptom fluctuation

Each question counted 1 point: 1 for ‘Yes’, 0 for ‘No’. The total was out of 8 points. The score classification determined the motoric subtype of delirium. A score of 0 meant ‘No delirium detected’. A score of 1-3 determined hypoactive delirium (sub-syndromal delirium) and a score of 4-8 determined hyperactive or mixed delirium (Bergeron et al 2001:862; Ouimet et al 2007:1007).The purpose of the ICDSC tool was to screen the

patients for hypoactive delirium and delirium (Bergeron et al 2001:862; Ouimet et al 2007:1007)..

2.13.5 Richmond-Agitation-Sedation score (RASS score)

This is a Sedation-Agitation score. This score can serve as a level of consciousness (LOC) assessment in all patients regardless what sedation medication they are receiving. The RASS score is reliable and valid for adult medical and surgical ICU patients and patients on constant sedation medication or without (Sessler, Gosnell, Grap, Brophy et al 2002:1338; Ely 2002:3). This score does not specifically screen for delirium but rather shows agitation (Bush, Grassau, Yarmo, Zhang et al 2014:8). The RASS score was validated with the CAM ICU tool to detect delirium, but any sedation agitation score can be used (Ely 2002:18). When the RASS score is -4 and -5, it is difficult to assess the patient because the patient is not responsive and cannot be assessed for any delirium score because the patient is in a coma or stupor. At RASS score -3 to +4, the CAM ICU score can measure clarity of thought, specifically delirium (Ely 2002:5, Ely et al 2001:2705). RASS -3 score is usually the cut-off point to asses patient for delirium (Ely 2002:5, Ely et al 2001:2705).

2.14 CHALLENGES WITH IMPLEMENTATION OF DELIRIUM PREVENTION BUNDLES

Frequent multi-team rounds to implement and sustain delirium care bundles into daily care of patient are necessary to enhance delirium prevention and to create an awareness about delirium prevention (Balas, Cohen, Franz & Vasilevskis 2013:124).The goal is to use less sedation than necessary and coordinate better from nurse specialists (Balas et al. 2013:124).Frequent and better mobilization of all ICU patients is necessary (Balas et al 2013:124).Resistance to change from nursing staff can be a problem, but resistance can be minimized by teaching nurses about how severe delirium can impact a patient’s life and recovery and what the impact of delirium will be on the patient if it develops (Rivosecchi et al 2015:47).Smith and Grami

(2017:26) found that mobilization of ICU patients twice a day was difficult due to staff shortages and that patients struggled to fall asleep and stay asleep for more than 4 hours. Furthermore, pain scores were not documented and sedation cessation for ventilated patients was not always used by doctors.

2.15 PHARMACOLOGICAL TREATMENT OF HYPOACTIVE DELIRIUM AND DELIRIUM

Clinical practice guidelines for management of pain, agitation and delirium in adult patients in critical care recommend first-line sedation with Dexmedetomidine® or Propofo®l for most ICU patients especially in the cardiac ICU (Barr et al 2012:305). Low dose short-term antipsychotic therapy may reduce delirium incidence and duration in elderly orthopaedic surgery patients (Devlin et al 2012:305). Perioperative low dose short-term antipsychotic treatment with haloperidol and risperidone may reduce risk among elderly cardiac and gastrointestinal surgical patients in the ICU and the use of Dexmedetomidine as sedation is preferred above Benzodiazepine based sedation (Devlin et al 2012:306). Cholinesterase inhibitors should never be used in the treatment or prevention of delirium (Devlin et al 2012:306). The routine use of antipsychotic medication in treatment of delirium is not recommended and evidence is weak (Devlin et al 2012:306). Delirium caused by alcohol withdrawal should be treated as the first line treatment is Benzodiazepine (Unger, Neuner, John, Wernecke & Spies 2013:684; Awassi et al 2013:58; Awassi et al 2013:22) and Phenobarbital combined with Benzodiazepine has advantages (Awassi et al 2013:58). Propofol® and Dexmedetomidine evidence is not overpowering, but should be given at the doctor's discretion (Awassi et al 2013:58). Clomethiazol should not be used due to the high risk of pneumonia and trachea-bronchitis due to increased secretions and EtOH is effective for prevention but not recommended (Unger et al 2014:684). Clonidine and Haloperidol have safety concerns but are proven as treatment for alcohol withdrawal treatment as well as Dexmedetomidine (Unger et al 2014:684).

At present there is no treatment specifically for delirium and low dose of sub-anaesthetic intraoperative bolus of ketamine should not be considered because it can increase postoperative nightmares and hallucination (Avidan et al 2017:2). Antipsychotic medication does not improve the outcomes when used for prevention or treatment of delirium (Neufeld et al 2016:6). Antipsychotics were also not associated with improvement in short-term mortality, severity or duration and length of ICU and hospital stay (Neufeld et al 2016:6).

2.15.1 Anti-psychotic treatment

The lowest effective dose of neuro-active drugs and sedation should be used and there should be an investigation for underlying causes like metabolic causes, pain, the presence of invasive lines and the use of deliriogenic drugs (Mistraletti et al 2012:323).

2.15.1.1 Haloperidol®

Act on Dopamine receptor and is the most commonly anti-psychotic treatment used for delirium and is the first line treatment according to the American Psychiatric Association (APA) because of the lack of respiration depression but it is associated with extra pyramidal symptoms and sedation (Grover et al 2011:279). Haloperidol usage in cardiac surgery delirious patients as sedation has been found ineffective and extra sedation needs to be used where morphine can be added (Atalan et al 2013:933). Haloperidol is a dopamine receptor antagonist which works on the inhibiting dopamine neurotransmission which results in positively decreasing symptoms of hallucination, agitation and combative behaviour and often results in sedation (Atalan et al 2013:936). Low dose anti-psychotic treatment may reduce delirium incidence, duration and severity in elderly patients, but evidence is not convincing about routinely using anti-psychotic medication especially in non-agitated patients (Devlin et al 2012:306). Low dose Haloperidol and Risperidone pre-operatively may reduce the incidence of delirium in elderly cardiac and GI surgical ICU patients (Devlin et al 2012:3016). Lorenzo, Aldecoa and Rico (2013:262) state that Haloperidol is the traditional treatment for delirium but prophylactic treatment with

Haloperidol has not been confirmed. Lorenzo et al (2013:262) add that second generation antipsychotic medication is a good alternative to Haloperidol with a better safety profile. Page et al (2013:521) found that Haloperidol has no different effect than a placebo on the duration of delirium and that Haloperidol should be reserved when non-pharmacological interventions do not succeed and the patient is a danger to himself/others. Haloperidol's effect on delirium was the same as the placebo that was saline (Page et al 2013:521). Page et al (2013:521) maintain that Haloperidol is useful for the management of agitation but not for treatment of delirium. Extra-pyramidal side effects of Haloperidol, neuroleptic malignant syndrome and prolonged Qtc interval are a problem (Mo & Zimmerman 2013:874).

2.15.1.2 Risperidone®

Risperidone is an atypical anti-psychotic drug with antagonistic effect on 5-hydroxytryptamine and dopamine D2 receptor which drug is known to cause fewer extra pyramidal symptoms than Haloperidol and can be considered as substitute treatment in the place of Haloperidol for delirium (Grover et al 2011:279; Devlin et al 2012:3016).

2.15.1.3 Olanzapine®

Act on Achetylcholine receptor and can be used in the place of Haloperidol to treat delirium and has fewer side effects than other anti-psychotic medication (Grover et al 2011:279; Devlin et al 2012:3016).

2.15.2 Sedation

Non-Benzodiazepine sedation is better than Benzodiazepine sedation in terms of mortality and length of ICU stay and extubation (Lonardo, Mone, Nirula, Kimball et al. 2014:1394)

2.15.2.1 Allosteric modulators of gamma-aminobutyric acid (GABA) receptor agonist

Benzodiazepine (Midazolam®) mode of action of midazolam: benzodiazepine receptor agonists act as allosteric modulators of gamma-aminobutyric acid (GABA) activity by binding to inotropic benzodiazepine receptors at the $GABA_{receptor}$ complex. Benzodiazepine receptor agonists serve to increase GABA binding and thus the frequency of chloride ion channel openings, facilitating inhibitory activity and demonstrate affinity for four benzodiazepine receptor subtypes (referred to as α_1, α_2, α_3, and α_5) located at the GABA complex (Walsh & Roth 2017:832). Organ failure risk was higher with benzodiazepine sedation than non-benzodiazepine sedation and these patients need more days of opiates compared to propofol patients (Lonardo et al 2014:1392). Midazolam was identified to increase delirium and is a potential modifiable risk factor (Sullah et al 2010:210). Reduction of Benzodiazepine use can improve brain dysfunction (Hughes, Brummel, Vasilevskis et al 2012:402). Invasive lines and midazolam use was associated with more diagnosis of delirium and should be a modifiable risk factor in ICU to prevent delirium by early mobilization and less sedation of patients (Salluh et al 2010:210).

Propofol® infusion is associated with lower mortality rates, shorter ICU stay and shorter ventilator support compared to Benzodiazepine use (Lonardo et al 2014:1392). Compared with propofol, dexmedetomidine sedation reduced incidence, delayed onset, and shortened duration of post-operative stay in elderly patients after cardiac surgery (Dhaiani, Silverton, Fedorko, Carroll et al 2016:362).

2.15.3 Analgesia and sedation

2.15.3.1 Morphine®

Opioid analgesia can be used in the place of Haloperidol in cardiac post-operative patients because it keeps the patient hemodinamically and respiratorily stable and onset is rapid and effective (Atalan et al 2013:937). Atalan et al (2013:936) used

Morphine and patients did not require any additional sedation as when using only Haloperidol. Opioids are often associated as a risk factor to develop delirium, but this is still unclear (Mo & Zimmerman 2013:836).

2.15.3.2 Alpha 2 adrenergic receptor agonist

- Dexmedetomidine®

The mode of action consists of Alpha 2 receptor agonist that acts on Noradrenalin (Devlin et al 2012:306) and is frequently used in ICUs because it has GABA receptor sparing activity, and minimal respiratory depression, opoid sparing effect, lack of anticholinergic activity and normal sleep-mimic activity (Mo & Zimmerman 2013:837). Dexmedetomidine has decreased sympathetic nervous system activation and is associated with cardiovascular adverse events in patients with decreased autonomic nervous system response like elderly, diabetic patients, chronic hypertension, valve stenosis, heart block, severe coronary artery disease or already hypotensive or hypovolemic patients (Pasin, Landoni, Nardelli, Belletti et al 2013:1459). This medication is used for sedation, analgesia and promotes better sleep patterns without respiratory depression and can be associated with less opioid use (Maldonado, Wysong, Van der Starre, Block et al 2009:207). Dexmedetomidine was used on non-cardiac surgery elderly patients and a low-dose infusion in the first 7 days after the surgery reduced the incidence of delirium significantly for patients intubated or not intubated and for all three types of delirium (Su, Ming, Cui, Li et al 2016:1898). Dexmedetomidine improved quality of sleep, decreased the prevalence of non-delirium complications, shortened length of ICU stay and increased early discharge from hospital (Su et al 2016:1898).

The use of Dexmedetomidine as sedation rather than Benzodiazepine based sedation may resolve delirium quicker (Devlin et al 2012:306). Dexmedetomidine was found to be more effective in treating and preventing post-operative delirium compared to Midazolam and Propofol ®(Maldonado et al 2009:207). There is strong evidence that Dexmedetomidine reduces delirium risk in ICU (Zaal et al 2015:45). Dexmedetomidine could help with the reduction and prevention of delirium, agitation and/or confusion in

critically ill patients (Pasin et al 2014:1462). Dexmedetomidine is linked with increased risk for bradycardia and hypotension although Pasin et al (2014:1462) found no increase in mortality. It is furthermore linked with shorter hospital stay and might reduce the time to extubation (Pasin et al 2014:1462). Dexmedetomidine is an effective sedation agent compared to Midazolam and propofo®l in ICU for patients requiring long-term mechanical ventilation (Mo & Zimmerman 2013:836). Myatra (2014:272) found that dexmedetomidine has sedation, analgesia and sympatholytic effects that provide sedation with reduction in respiratory depression and delirium.

- Clonidine®

This drug can be used with success in patients with delirium who are not responding to neuroleptic drugs (Maldonado 2009:207; Devlin et al 2012:3016).

2.15.3.3 Cholinesterase inhibitors (Donepezil®/Rivastigmine®)

This drug should not be used in routine use and prevention of Delirium (Devlin et al 2012:3016).

Clomethiazol®: This drug should not be used due to the high risk of pneumonia and trachea-bronchitis due to increased secretions (Unger et al 2014:684).

2.16 CONCLUSION

This chapter discussed the literature review conducted for the study on all types of delirium, causes, prevention and pharmacological and non-pharmacological treatment of delirium.

Chapter 3 describes the research design and methodology used in the study.

CHAPTER 3 RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 2 discussed the literature review conducted for the study, focusing on hypoactive delirium and delirium. This chapter discusses the research design and methodology.

3.2 RESEARCH DESIGN

A research design is “a set of logical steps taken by the researcher to answer the research question” (Brink et al 2006:92).

The researcher selected a quantitative, quasi-experimental non-equivalent control group design for the study (Babbie 2010:371; Polit & Beck 2016:266). Non-equivalent control group pre-post-test designs are frequently used and involve an experimental treatment and two groups of subjects observed before and after its implementation (Polit & Beck 2016:266). Research should not only benefit the researcher but the community as well and should improve existing services (Bothma et al 2010:5).

3.2.1 Quantitative design

Bothma et al (2010:82) refer to a quantitative design as “an essential tool for generating knowledge in nursing science” and for providing evidence for nursing practice, education and management. Quantitative research is numerical information that results from some type of formal measurements which are analysed with statistical procedures (Babbie 2010:23; Polit & Beck 2012:17). Quantitative analysis is “the numerical representation and manipulation of observation for the purpose of describing and

explaining the phenomena that those observations reflect" (Babbie 2010:422). In this study a quantitative design was utilized because numeric data on the ICDSC scores was gathered and analysis was done to investigate if the ICDSC scores improved with the implementation of non-pharmacological interventions.

3.2.2 Quasi-experimental design

A quasi-experimental design differs from an experimental design in that there is no randomization of participants to the control and experimental group (Babbie 2010:371; Polit& Beck 2012:266). This design was used to control as many threats to validity as possible when one of the three aspects, control, randomisation and manipulation was not met (Botma et al 2010:5). Moreover, before and after comparisons data could be investigated which could lead to paired data where for each subject there was baseline data before and after data (Bruce, Pope & Stanistreet 2008:347).

A quasi-experimental design was utilised in this study because randomization was not met, which resulted in the classification of a quasi-experimental design. However, the groups were as similar as possible from the start (post-cardio-thoracic patients) and inclusion and exclusion criteria were met which generated similar baseline data (Babbie 2010:371; Polit & Beck 2012:266).The researcher could assume if the baseline data was similar at the onset of the study, that the pre and post-test differences could be due to the result of the intervention (Polit & Beck 2012:267). If the control and intervention groups were similar before the intervention (pre-test), the researcher could assume that the post-test differences were because of the intervention done (Polit & Beck 2012:267). The control group formed the group against which the outcomes of the interventions were measured (Polit & Beck 2012:267). This design was used to examine causality and to control as many threats to validity as possible in a situation where one (randomisation) of the following three criteria was not met: control, randomisation and manipulation (Bothma et al 2010:115).

Patients might be more willing to participate in quasi-experimental designs because they do not willingly want to be randomized (Polit & Beck 2012:272). The results might be less conclusive and not generalized due to the layout of the unit where the study was done (Polit & Beck 2012:272). The patients lay next to each other, so it was not possible to randomize the control and intervention groups due to the nature of the intervention and risk of contamination of results.

3.2.3 Pre-test post-test design

The pre-test post-test design was used because it measures change of the dependant variable (Fox 2008:81). This could assist in determining differences between the control group, who received standard nursing care, and the intervention group, where non-pharmacological interventions were implemented. This design could measure change and determine differences between the control group and the intervention group (Bothma et al 2010:121). This design was utilized because the difference between the pre-test ICDSC scoring and the post-test ICDSC scoring was measured where standard nursing care was rendered compared to adding non-pharmacological interventions to standard nursing care.

A good experimental design is where groups of participants who are initially equivalent with the pre-test, are randomly assigned to receive the experimental treatment and assessed again after the intervention in the post-test phase (Crano, Brewer, Lac 2015:34). This could not be done due to the layout of the unit and the risk of data contamination.

A pre-test is important because it makes it possible to determine that participants assigned to control and intervention groups are initially equivalent in their response to the dependent variable (Crano, Brewer, Lac 2015:34) which will be hypoactive delirium and delirium is screening using the ICDSC checklist for positive screening. The success of a two group experimental design is that the experimental and control group are equivalent on all factors except the exposure to the different levels of the

independent variable (non-pharmacological interventions) (Crano, Brewer, Lac 2015:34) which was initiated by inclusion and exclusion criteria.

The ideal of comparing the control and intervention group is to hold some variables constant and maintain the same level for all participants (inclusion criteria) and test patients the same time of the day using the same screening tool ICDSC (Crano, Brewer, Lac 2015:34). If measures could not be held constant, random assignment should have been used, which in this study was not met because of the layout of the ICU unit. Patient lie next to each other in close proximity and the risk of data contamination will be too high.

Random assignment requires that all participants who fit the inclusion criteria would be assigned to control or intervention group by chance (Crano, Brewer, Lac 2015:34). If any other basis for selection was used to choose participants than chance (randomization), it could lead to treat to internal validity, selection, and may be that any difference in outcome can be due to not the intervention but by other factors (Crano, Brewer, Lac 2015:34).

Chance assignment assured that there were no pre-existing systematic differences between participants like average age, sex, educational background and intelligence (Crano, Brewer & Lac 2015:34). Inclusion criteria and the same profile patients (post-operative cardio-thoracic patients) were used in the control and intervention group (Crano et al 2015:34) who underwent cardiac artery bypass graft or valve replacement surgery. Their anaesthesia is usually similar and the type of medication they receive post-operatively is the same type of analgesia and sedation.

Pre-test sensitization could be a problem because the pre-test could cause the treatment to appear stronger or more effective since the participants knew that the researcher would screen for hypoactive delirium and delirium is and could be more alert. This is more likely when the intervention is followed in the same session as the pre-test (Crano et al 2015:34). This can be minimized by administering the pre-test days

or weeks before the intervention so that the participants do not make a strong connection (Crano Brewer, Lac 2015:34), but this was not be possible, because the participants were screened for hypoactive delirium and delirium is on the 1st post-operative day and if hypoactive delirium and delirium was present, patients were first enrolled into the control group (phase 1) and then into the intervention group (phase 2). The control group received normal standard nursing care and the intervention group received the non-pharmacological interventions.

3.2.4 Non-equivalent control group pre-post-test

Non-equivalent control group pre-post-test designs are frequently used and involve an experimental treatment and two groups of subjects observed before and after its implementation (Polit & Beck 2012:266). In figure 3.1 O represents the observation Pre-test (O_1) and Post-test (O_2) and X represents the intervention (Polit & Beck 2012:266). The top line represents the control group with no intervention and the second line represents the intervention group with an intervention (Polit & Beck 2012:266).

0_1		0_2
0_1	x	0_2

Figure 3.1 Non-equivalent group design before-after design (Pre-post-test)

The baseline data is assumed to be similar at the onset of the study with the help of inclusion and exclusion criteria (Polit & Beck 2012:266). The post-test data would then be the cause of the intervention (Polit & Beck 2012:266), but due to no randomization before observation the design is weaker because it can no longer be assumed that the control and experimental groups are equivalent at the start of the study (Polit & Beck 2012:266). This design was chosen because the change in ICDSC scoring pertaining hypoactive delirium and delirium was investigated between the pre-test and the post-test scorings of each patient in the control and intervention groups separately.

Figure 3.2 illustrates the design and how the study was conducted.

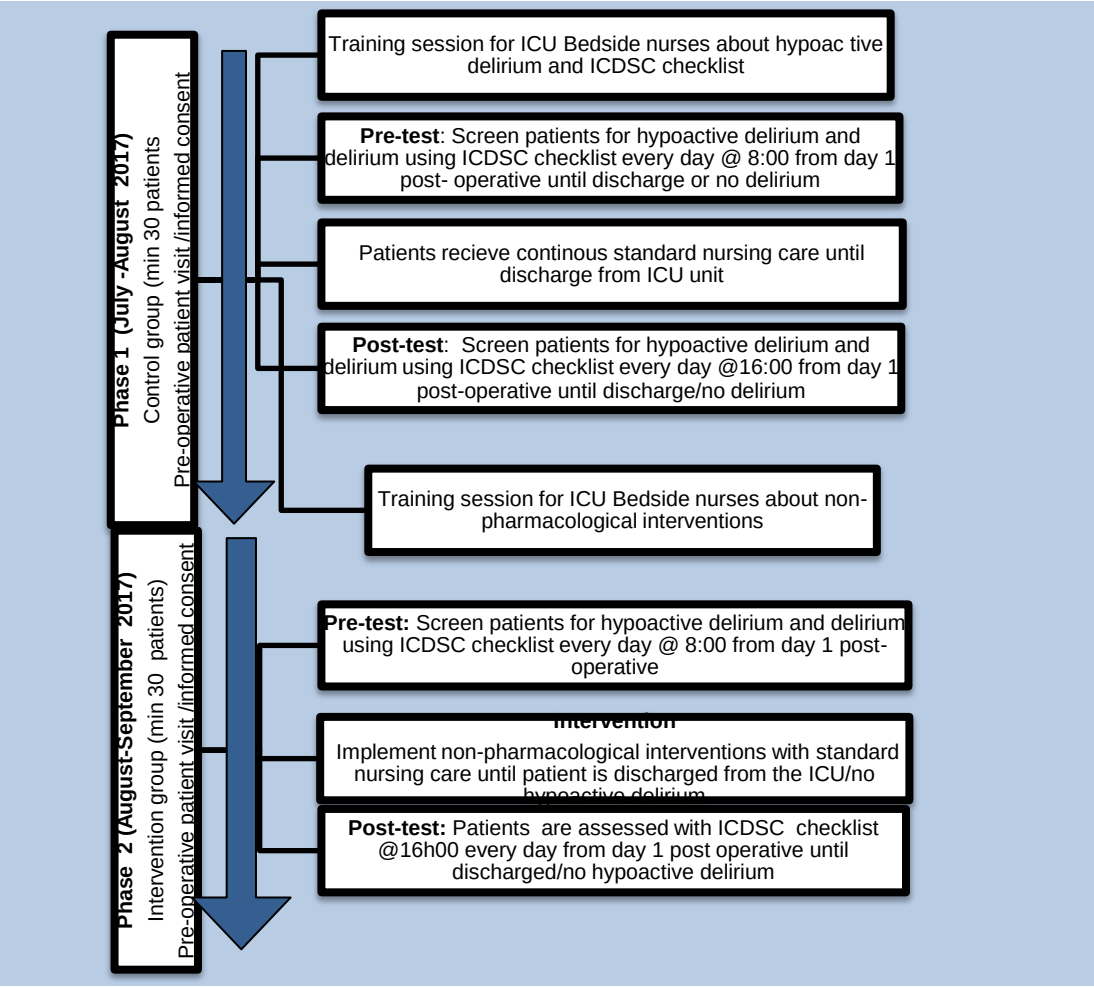

Figure 3.2 Quasi-experimental non-equivalent control group design

The study was conducted in two phases:

- Phase 1: Control group: Assessment (pre- & post-test) of hypoactive delirium and delirium is patients in the control group who received standard nursing care
- Phase 2: Intervention group: Assessment (pre & post) of hypoactive delirium and delirium patients who received non-pharmacological interventions.

3.3 RESEARCH METHODOLOGY

The research methodology is the plan for conducting the specific steps of a study (Burns & Grove 2014:707). Research methods are the techniques used to structure a study and to collect and analyse data relevant to the research questions systematically (Polit & Beck 2016:741). The research methodology includes the setting, population, sampling and sample, and data collection and analysis.

3.3.1 Setting

In research, the setting is "the site or location used to conduct a study" (Burns & Grove 2014:373). The setting was a private hospital in Gauteng province with an 18-bed cardio-thoracic intensive care unit. The study participants were adult patients who had undergone cardio-thoracic surgery. There are four cardio-thoracic surgeons working in this unit and the bed occupancy ranges between 95-100%. The nurse to patient ratio is 1 ICU patient to 1 ICU nurse and 2 high care patients to 1 ICU nurse. The patients usually stayed 3 to 4 days in ICU before being transferred to the ward.

3.3.2 Population

A population is "the entire aggregate of cases in which a researcher is interested" (Polit & Beck 2016:743). The study population included all post-cardio-thoracic surgery patients who were admitted in the selected ICU where the study was conducted. The patients who gave voluntary consent were screened pre-operatively by ICU nurses and the researcher post-operatively for hypoactive delirium and delirium, using the ICDSC checklist from day 1 after the surgery.

To be included in the study, the participants had to be

- Older than 18 years.
- Admitted for cardio-thoracic surgery, specifically cardiac artery bypass graft and valve replacement surgery, because they receive similar post-operative sedation and analgesia that could have a pharmacological effect on the incidence of hypoactive and delirium.
- Able to understand, read and speak English, because the ICDSC checklist is in English, so if the patient do not understand English, he/she would not understand the questions and obey commands that would influence the outcome.

Patients were excluded from the study if they

- Had a known history of dementia, neurological disorders, alcoholism, or psychosis, because they could present with hypoactive delirium and delirium are due to their known disease.
- Were too sedated post-operatively with a Richmond agitation sedation score (RASS) of more than -4, because they would not be able to respond to questions on the ICDSC checklist.

3.3.3 Sampling and sample

A sample refers to a subset of a population (individuals, elements or objects) or a group selected to act as representatives of the population as a whole (Polit & Beck 2012:275). Sampling refers to the “process of selecting the sample from a population in order to obtain information regarding the phenomenon in a way that represents the population of interest” (Brink et al 2006:124).

In convenient sampling, the participants who agree to participate and meet the inclusion criteria are enrolled into the study. Convenient sampling is when participants are available and consent to participate in a specific study (Burns & Grove 2013:365). Sampling in this study was done by approaching the participants and there families the day before the surgery in the ward during a pre-operative visit by the researcher which

is a cardio-thoracic nurse. The study was explained and the participants and the participants had a choice to participate or not without being scared of compromised nursing care. Informed consent was only signed after the participant and usually the family agreed to take part in the study.

3.3.3.1 Sample size determination and power

In collaboration with the statistician, the following aspects of the sample size were concluded:

- The sample size calculation was based on delirium severity (score) regarded as the primary outcome in this study.
- A standard deviation for change in delirium score over 24 hours was set at 1.
- A sample size of a minimum of 30 participants per group would have 90% power to detect a clinically relevant improvement in delirium score of 1 after 24 hours for the non-pharmacological intervention versus the control group when testing one-sided at the 0.05 level of significance.
- The statistician advised a minimum sample size of 30 participants per group (total minimum of 60 participants) to allow for a predicted drop-out from treatment of around 25%. The final sample size was 60 participants who took part in this study. Each participant was screened for hypoactive delirium and delirium for 3-4 days twice daily.

3.3.3.2 Statistical method

In collaboration with the statistician the following aspects of the statistical method were concluded:

In the primary analysis, changes in delirium score (ICDSC score) between the intervention and control group was compared with respect to change from baseline, using a two-tailed two sample T-test assuming unequal variance.

- Secondary outcomes would be analysed similarly.
- Data summary would employ descriptive statistics mean, standard deviation and 95% confidence intervals for continuous variables.

- Data summary would employ descriptive statistics, frequency distributions for categorical variables.

Testing was done at the 0.05 level of significance.

3.3.4 Data collection *(See Annexure D1-D6)*

Data was collected (the ICDSC scoring) before and after the intervention (standard nursing care or non-pharmacological interventions) to achieve the objectives and if a significant statistical difference was found between control and intervention group, then it was assumed that the experimental treatment (non-pharmacological interventions) was the primary cause (Polit 2012:213; Fox 2008:81).

Data was collected in two phases.

3.3.4.1 Training session (See Annexure C2&D4)

Prior to commencing Phase 1, the researcher conducted training sessions during day and night shifts until all the nursing staff had attended an information session. Information was provided regarding screening for hypoactive delirium and delirium using the ICDSC checklist. Consensus was reached on the exact time of screening post-operatively and suggested at 8:00 and 15:00. ICU bedside nurses signed informed consent after the information session. If a nurse did not want to take part in the study she was excused from the training, but none of the nurses refused to not take part in the study. The researcher presented the information session in such a way that the ICU bedside nurse understood that this non-pharmacological interventions could only benefit the patient and not cause harm because it is a change in nursing care rendered. ICU bedside nurses explained as well in the information session that they do not have any knowledge about hypoactive delirium and delirium and the ICDSC checklist to score patients. An agreement was made with the matron and unit manager of the ICU that if it should have happened that an ICU nurse refused to take part in the research project the allocation should be changed if she had to look after a participant who was enrolled into the study. An agreement was done with the above managers that if it should happen that a nurse did not want to take part into the study, the researcher herself would nurse the participant as the researcher was capable to do so. This did not happen during the

research project, instead ICU bedside nurses was eager to participate because the change in nursing care rendered with non-pharmacological interventions improved the ICU experience of a ICU patient into a more pleasant experience. Shift leaders of the specific ICU agreed as well to assist the researcher during data collection to assure that ICDSC scoring and implementation of standards nursing care and later non-pharmacological interventions together with the standard nursing care was implemented correctly and accurately. ICU bedside nurses agreed to assist the researcher with the research project which implies completing section A, B, C, D.

3.3.4.2 Phase 1: Control group (See Annexure B1)

The control group consisted of 30 patients who met the inclusion criteria and gave voluntary consent pre-operatively. The researcher conducted a pre-operative visit to the patients admitted for cardio-thoracic surgery. The patients were informed about the study, and once they agreed to participate, informed consent was signed. The informed consent was done the day pre-operatively to ensure the patients did not receive any sedation or narcotic agents. This was done by the researcher herself. The patients in the control group continuously received normal standard nursing care until discharged from the ICU and were assured that they received all the usual nursing care normally associated with the surgery. They were assessed for hypoactive delirium and delirium using the ICDSC checklist at 8:00 (pre-test) and again at 16:00 (post-test) from day 1 post-operatively until discharged or no hypoactive delirium or delirium was detected. This was accomplished with the assistance of the ICU bedside nurses and the researcher assisting them. Patients who did not voluntarily give consent were also assured that they would receive the entire normal standard nursing care post-operatively that is usually rendered after the surgery.

3.3.4.3 Training session (See Annexure C2)

Prior to commencing Phase 2, the researcher conducted information sessions via PowerPoint presentations (see Annexure C2) in the lecture room during day and night shifts until all nursing staff had attended an information session. Information was

provided regarding the importance of screening ICU patients for hypoactive delirium and delirium using the ICDSC checklist. Hypoactive delirium and delirium and the complications thereof were discussed in detail. Consensus was reached on the exact implementation of non-pharmacological interventions (see table 3.1). ICU bedside nurses was handed out an ICDSC checklist to score a patient for hypoactive delirium and delirium and had to study the checklist consisting out of 8 questions. The researcher, who was also a qualified ICU nurse and shift leader, assisted the ICU nurses in scoring each morning at 8:00 and 15:00 herself at each participant to assured correct scoring. The researcher was available on the ICU floor during the day to assure standard nursing care and later non-pharmacological interventions was implemented correctly and efficiently and gave in-service training to ICU bedside nurses if needed to. The ICU bedside nurses who was allocated to the specific participants was highly trained in intensive care nursing and was guided by the researcher and the shift leaders of the day and night to assure that interventions applied was of high standard.

3.3.4.4 Phase 2: Intervention group (See Annexure D1)

The intervention group consisted of 30 patients who met the inclusion criteria and gave voluntary consent pre-operatively. The researcher conducted a pre-operative visit to the patients admitted for cardio-thoracic surgery. The patients were informed about the study, and once they agreed to participate, informed consent was signed. The informed consent was done the day pre-operatively to ensure the patients did not receive any sedation or narcotic agents. The patients in the intervention group received non-pharmacological interventions together with standard nursing care until discharged from the ICU. They were assessed for hypoactive delirium and delirium is using the ICDSC checklist at 8:00 (pre-test) and again at 16:00 (post-test) from day 1 post-operatively until discharged or no hypoactive delirium and delirium is was detected or the patient became unable to respond to questions with an RASS score more than -4. Those patients were then excluded from the study. Once the participant was discharged from the ICU to the ward, delirium screening was discontinued because the research project did not include the ward. 2 participants was discontinued during the data collection

because of RASS score more than -4, to sedated to respond to questions and unable to be screened for hypoactive delirium and delirium.

3.3.4.5 Intensive Care Delirium Screening Checklist (ICDSC)

Patients were screened with the ICDSC (See Annexure B2) every day after the first post-operative day at 8:00 for hypoactive delirium and delirium until no delirium/delirium free was present or the patient was discharged to the ward. The screening was done by the ICU bedside nurse who was trained how to screen for hypoactive delirium and delirium accompanied by the researcher herself. Thirty (30) minutes were allocated to screen the patients at 8:00 and 16:00 although the screening checklist consisted of 8 questions which could be done in 5 minutes. The reason why the ICDSC checklist was utilized and not the CAM ICU tool, was that the ICDSC screen the patient for a 24 hour period and differentiate between hypoactive delirium and delirium where the CAM ICU tool is shorter and easier to use consisting out of 4 questions, but do not differentiate between hypoactive delirium and delirium.

This checklist is widely used because it can identify hypoactive delirium and delirium where other checklists or scales can only detect delirium in totality (Bergeron, Dubois, Dumont, et al 2001:862; Ouimet et al 2007:1007-1013). The ICDSC can be used to screen the patient throughout the whole shift and is nurse friendly to use (Bergeron, Dubois, Dumont, et al 2001:862; Ouimet et al 2007:1007-1013). Numbers 1-4 need bedside assessment of the patient, if the patient is deeply sedated or comatose (RASS -4 or -5) patient cannot be assessed. Numbers 5-8 are observed throughout the whole shift. Information from the previous 24 hours is needed for numbers 7 and 8 (Bergeron, Dubois, Dumont, et al 2001:862; Ouimet et al 2007:1007-1013).

3.3.4.6 The intervention: Non-pharmacological interventions

Non-pharmacological interventions was added by the standard nursing care rendered to post-operative cardio-thoracic participants which consisted out of (See Annxure D2)

normally consist of the following (Ely 2002:1-32; Martinez et al 2012:630; Rivosecchi et al 2015:47; Shaughnessy 2002:1475):

- Provide visual and hearing aids
- Encourage communication and reorientation hourly
- Have family objects from home
- Allow television/radio use
- Allow non-verbal music
- Sleep hygiene: lights off 14:00-15:00
- Control excess noise
- Mobilize patient twice daily
- Minimize physical restraints used
- Sedation weaning
- Removal of intravenous lines as quickly as possible.

Chapter 2 discusses the non-pharmacological interventions in detail. Table 3.1 outlines the non-pharmacological interventions for this study (Ely 2002:1-32; Martinez et al 2012:630; Rivosecchi et al 2015:47; Shaughnessy 2002:1475)**.** Non-pharmacological interventions were added to standard nursing care of post-operative nursing care of a cardio-thoracic patient which is covered by the doctor and nursing prescriptions on the basis of the patient need assessment and the scope of practice of a professional and enrolled nurse. How the nursing care rendered changed was that non-pharmacological interventions specified below in table 3.1 was added to the normal nursing care rendered by a ICU nurse. Some of the non-pharmacological interventions like every hour orientating the patient or telling the time was automatically done by ICU nurses and big watches are visible in the unit for patients to see clearly. Non-pharmacological interventions which was set apart from normal nursing care is photo's around the bed, implementation of a sleeping hour, playing of music, orientation of a patient every hour if he/she is awake, supplying earplugs and eye masks at night and keeping the noise level down in the unit. This was done during the research which differs dramatically from normal standard nursing care rendered in this specific ICU unit where the study was conducted. Participants who did not want to take part in the research (one participant) was allocated to a private cubicle where the glass doors could be closed so that the above interventions would not interfere in his normal nursing care, e.g. The music would not be heard

and the sleeping hour where the whole unit was darker would not disturb him.

Table 3.1 Non-pharmacological interventions implemented in the study

Intervention	Action
i) Provide visual (glasses/contact lenses) and hearing aids	Provide visual and hearing aids, if applicable, to ensure patients can see and hear properly.
ii) Communicate and re-orientate hourly	ICU nurse will orientate the patient hourly regarding time, place, and person. Clocks must be visible in the unit and calendars at each bed, showing day, month and year.
iii) Provide a family photo from home	Ask family pre-operatively to provide a family photo that can be used post-operatively at the bedside.
iv)Play classical music	Play classical music during the day, except during the time patients must sleep/rest
v) Ensure quiet environment	Control noise, restrict visitors and doctors rounds during the indicated times.
vi) Implement sleep hygiene between 13:00-14:00 and 22h00 – 04h00	Switch lights off at indicated times. Provide each patient with ear plugs as well as an eye pad, to ensure silence and rest
vii) Minimize physical restraints	Avoid using physical restraints, if possible
viii) Sedation weaning	Wean sedation actively to maintain a RASS/sedation score above -1
ix) Removal of intravenous lines as quickly as possible	Advocate for the removal of invasive lines as quickly as possible
x) Mobilize patient twice daily	Mobilize patient into a chair @7:00 and 12:00 for breakfast and lunch.
xi) Extend visiting times	Allow visitors to visit patient for more than 1 hour if patients can tolerate visitors.
Xii) Provide cognitive stimulation	Provide a 24-piece puzzle to be built daily when mobilised into a chair.

Table above adapted from: Ely 2002:1-32; Martinez et al 2012:630; Rivosecchi et al 2015:47; Shaughnessy 2002:1475

3.3.4.7 Hypoactive and delirium screening checklist

The delirium screening and implementation of non-pharmacological interventions checklist (See Annexure D2) stipulated the inclusion and exclusion criteria; demographic data, and pre-and post-operative risk factors which were identified with delirium incidence (see Annexure B2).

The hypoactive delirium and delirium screening checklist consisted of four sections:

Section A

1. Inclusion criteria
2. Exclusion criteria
3. Pre-operative exclusion criteria
4. Demographics

Section B

- Pre-test: ICDSC checklist

Section C

- ICU Bedside tick list for non-pharmacological interventions with intervention group

Section D

- Post-test: ICDSC checklist

The researcher assisted the ICU bedside nurse with the ICDSC scoring to assure accuracy and compliance. Section A was completed by the researcher and Section B, C, D by the ICU bedside nurses assisted by the researcher every day and every participant. This was done to assure accurate data collection and to train ICU bedside nurses so that the research project will ultimate result in better quality nursing care rendered.

3.3.5 Data analysis

Data analysis is the systematic organization and synthesis of data to establish order, structure and meaning to qualitative data collected (Polit & Beck 2016:288; Bothma et al 2010:220).

A private statistician analysed the data and presented the results in descriptive statistics. The data presented to the statistician was done on a excel spreadsheet which was completed by the researcher after sections A, B, C, D was completed as specified in section 3.3.4.7. Descriptive statistics are used to describe and generate data by averages and percentages (Polit & Beck 2016:558). Inferential statistics are also used to make inferences about the population used and to use the laws of probability to make a conclusion about the population (Polit & Beck 2016:583). Calculations of the ICDSC checklist scores were used to generate data (see Annexure B). See chapter 4 for results and discussion.

3.4 VALIDITY

Validity refers to the degree to which an instrument measures what it is intended to measure (Brink et al 2006:109). Threats to validity are reasons that the research inference could be wrong and the researcher must try to minimize the potential threats to validity to strengthen the evidence (Polit & Beck 2012:236). In this study, the researcher ensured content and internal validity. Threats to validity are reasons that the research inference could be wrong and the researcher must try to minimize the potential treats to validity to strengthen the evidence (Polit & Beck 2016:236).Validity refers to the degree to which a measurement represents a true value and to what degree the researcher provides evidence to validate that the effect resulted due to hypothesis testing (Bothma et al 2010:174).

3.4.1 Content validity

Content validity refers to what the instrument used should measure, what the instrument is intended to measure, and to what extent the instrument is a representative sample of the content being measured (Bothma et al 2010:174; Burns & Grove 2009:377; Leedy & Ormrod 2011:93). In this study, the content being measured was hypoactive delirium and delirium and content validity was ensured by utilising a validated assessment tool (ICDSC). The aim of the ICDSC is to screen patients for the incidence of hypoactive delirium and delirium (Gusmao-Flores, Salluh, Chalhub & Quarantini 2012:1; Bergeron et al 2001:862; Quimet et al 2007:1007).

3.4.2 Internal validity

Internal validity refers to the concern that the cause of the outcome is due to the independent variable and not due to other factors (Polit & Beck 2016:287).The researcher should design the study to rule out other causes of hypoactive delirium and delirium in participants, by including inclusion and exclusion criteria. The effects of history, maturation, instrumentation and statistical regression should be addressed to minimize threats to internal validity (Bothma et al 2010:117; Polit & Beck 2016:287). To establish a causal relationship, the cause must precede the effect and is referred to as temporary ambiguity (Polit & Beck 2016:287). Temporal causality means that the cause must precede the effect (Polit & Beck 2016:287). The researcher established this aspect by screening the participants for hypoactive delirium and delirium utilizing a validated screening checklist, the ICDSC. The empirical relationship between the presumed cause and the presumed effect must be addressed (Polit & Beck 2016:287). This was done by utilizing previous evidence explaining the effect of non-pharmacological interventions on the incidence and duration of hypoactive delirium and delirium (Speed 2015:94). However, hypoactive delirium and delirium can also be caused by pharmacological interventions (medication) used as stated by the third variable of causality (Polit & Beck 2016:287). This will result in the possibly that hypoactive delirium and delirium could result from pharmacological interventions (medication) and

not just the implementation of non-pharmacological interventions. The researcher, who is a registered nurse, could only influence the non-pharmacological interventions (intensive care environment) and had no influence over medications prescribed by the physician.

3.4.2.1 The selection of participants:

The above mentioned could result due to bias of pre-existing differences between groups and participants' not being assigned randomly to groups which could make the groups un-equivalent (Polit & Beck 2016:295). For this reason, only cardio-thoracic participants who had undergone cardiac artery bypass surgery and valve replacement surgery were screened post-operatively on day 1 after the surgery, because the anaesthesia and post-operative Intensive care treatment regimen are similar and they lie next to each other in the intensive care unit. The participants were also enrolled in the study utilizing inclusion and exclusion criteria as specified by previous research done and criteria's established by (Pun & Ely 2007:626; Shaughnessy 2002:1475; McPherson et al 2013:405; Vasilevskis et al 2012:277; Pipanmekaporn et al 2014:9:879; Barr & Pandharipande, 2013:109).

3.4.2.2 History:

History poses as well a threat to internal validity. This entails external events that take place together with the independent variable (non-pharmacological interventions) that can influence the outcome of the dependent variable (hypoactive delirium and delirium) (Bothma et al 2010:118; Polit & Beck 2016:297). Events could occur to the patient between the pre- and post-test which could threaten the validity of the results and measures to prevent this should be implemented by the researcher as far as possible. If a participant's condition deteriorates during the study and he/she becomes unresponsive, it will not be classified as hypoactive delirium anymore. The participant will be discontinued from the study because only participants who screen positive for hypoactive delirium will be enrolled into the study after selection and informed consent. The same pre- and post-test instruments will be used, the ICDSC to screen for hypoactive delirium.

3.4.2.3 Maturity:

Maturity refers to the concept of changes that occur during the passage of time that could be interpreted in this study as participants' mental status (no delirium status) improving over the course of their intensive care stay and not just the implementation of non-pharmacological interventions (Polit & Beck 2016:297).

3.4.2.4 Mortality and attrition:

Mortality and attrition refer to threats that can arise from groups being compared that are not similar (Polit & Beck 2016:296). To limit this threat in this study, the researcher enrolled participants who were as similar as possible into the control and intervention groups by utilizing inclusion and exclusion criteria based on risk factors. The participants were also screened for hypoactive delirium and delirium with the same ICDSC which formed the pre- and the post-test. Mortality of participants before research is completed and post-test done

is a threat which can create bias to change the initial group of assessment (Bothma et al 2010:116).

3.4.2.5 Testing and instrumentation:

The above mentioned aspect is the last threat to internal validity. Testing entails sensitizing participants with the use of the same pre- and post-test test instrument (Polit & Beck 2016:297). Participants were exposed to the same questions in the pre-test as in the post-test. In this study, the pre-test and post-test were done 8 hours apart, but the ICDSC checklist to identify hypoactive delirium and delirium was designed to evaluate the participant continuously throughout the course of the intervention/normal nursing care. This is why this specific checklist was utilized and not the Confusion Assessment Method for ICU (CAM ICU tool), which only gives a score on the exact timeline the participant is asked questions (Bergeron et al 2001:862; Ouimet et al 2007:1007). Question 1 of the ICDSC evaluated the participants' fluctuation of consciousness over 24 hours and question 8 screened for fluctuation of symptoms in any of the ICDSC questions over a 24-hour period. This information was gathered with the assistance of

the ICU bedside nurses and ICU documentation of the Richmond agitation sedation score already on the ICU chart. The RASS scale is necessary to utilize because if a patient has a score of -4, the participant is to sedated to be scored for hypoactive delirium or delirium and could not take part in the research project. Such a patient would then be discontinued on the research project and this was as well explained pre-operatively during informed consent.

Instrumentation threat to internal validity refers to different instruments being used to assess the same variable or if the instrumentation tool yields more accurate measures on the second administration or less/more accurate on the second attempt (Polit & Beck 2016:297). In this study, the researcher screened the participants without any assistance from ICU bedside nurses to prevent incorrect screening and the same instrument was utilized, the ICDSC which measures hypoactive delirium and delirium by a point system and is a validated reliable assessment tool recommended for usage (Bergeron et al 2001:862; Ouimet et al 2007:1007). Statistic regression of the mean as a result of the testing is a threat (Bothma et al 2010:116).

3.4.3 Reliability

Reliability is consistency with what the measuring instrument measures, the result when the entity measured has not changed and reflects how the researcher could have made errors in the measurements (Leedy & Ormrod 2010:29). Hypoactive delirium and delirium was measured consistently by using a validated screening tool (ICDSC) and in-service training on how to use the screening tool to all ICU bedside nurses.

3.4.3.1 Reliability coefficient:

The measuring tool involved test-retest reliability, which means that the researcher administered the test twice on the same sample on different occasions and then compared the scores (Leedy & Ormrod 2010:93; Polit & Beck 21012:453). This was done by utilizing the same hypoactive delirium and delirium screening tool (ICDSC) as pre-test and post-test and comparing the data. The difference in the measurements

received is given as a reliability coefficient which gives an estimate of the reliability of the measured tool (Polit & Beck 21012:453).

3.5 LIMITATIONS

A limitation in the design was the *Hawthorne effect*. This refers to the effect when participants are possibly aware that they are being studied and alter their actions (Polit & Beck 2016:264). In this study, the participants were aware that they were being studied because they signed informed consent and the intensive care bedside nurses were aware of the study because an information session was held to inform them. To limit this effect as far as possible, the researcher screened the participants for hypoactive delirium and delirium to ensure equal screening. ICU bedside nurses could alter their nursing because the researcher was observing standard nursing care rendered to the control group as well as the implementation of non-pharmacological interventions on the intervention group. The ICU bedside nurses might try to make a good impression on the researcher (Bothma et al 2010:86). Other limitation that arose was that some participant did not want a lot of photos around there bed, because they are private. One participant had a special needs child which he did not want everyone to see. With the photos around the bed it created connection point between nurse and patients. Most of the participant did not want to utilize the earplugs and eye masks at night because they said they felt unsafe if they could not hear or see in an unknown intimidating environment scary which is in an ICU.

Another limitation in this study was that the researcher did not investigate the ICU nurses knowledge formally on all classes of delirium and delirium prevention before training was given, but according to Carruthers, Barr, Spurlock, Ridley et al 2013:128 most nurses have a knowledge deficit about all aspects of delirium prevention and care. ICU nurses have a knowledge deficit (Carruthers, Barr, Spurlock, Ridley et al 2013:128). The above was only done in a informal way of raising hand and answering a few questions about delirium and delirium prevention. No formal test was handed out

before the onset of training sessions which resulted into a limitation. Nurses do have a very important role in delirium bundle implementation and delirium prevention (Balas 2012:46; Hughes et al 2012:402) and they have the greatest influence over a successful non-pharmacological intervention plan implementation because they have the most patient contact (Rivosecchi et al 2015:47).

3.6 CONCLUSION

This chapter discussed the research design and the methods used in the study to address the aim, objectives and to test the hypothesis.

Chapter 4 presents the data analysis and interpretation, and findings.

CHAPTER 4 DATA ANALYSIS, INTERPRETATION, AND RESULTS

4.1 INTRODUCTION

Chapter 3 discussed the research design and methodology in detail. This chapter discusses the data analysis and results. The results are discussed with reference to the literature review to link the findings.

4.2 AIM AND OBJECTIVES

The aim of the study was to assess the effect of non-pharmacological interventions on the severity and duration of hypoactive delirium and delirium in ICU patients following cardio-thoracic surgery.

The objectives of the study were to assess

- The prevalence of hypoactive delirium and delirium during pre-test scoring with the Intensive care delirium screening tool (ICDSC) (08:00) on post-operative cardio-thoracic patients.
- The effect of implementation of non-pharmacological interventions nursing care versus normal standard nursing care on the severity and duration of hypoactive delirium (in hours) in ICU patients following cardio-thoracic surgery.
- The effect of implementation of non-pharmacological interventions nursing care versus normal standard nursing care on the severity and duration of delirium (in hours) in ICU patients following cardio-thoracic surgery.

4.3 PARTICIPANT COMPOSITION

The participants were all post-cardio-thoracic surgery patients admitted in the selected cardio-thoracic unit who met the inclusion criteria and agreed to participate. Data were collected in the selected cardio-thoracic unit. There were 30 participants

in the control and 30 participants in the intervention group. The participants in both groups were screened for pre-operative risk factors.

The study was conducted in two phases:

- Phase 1: Control group: Assessment (pre- and post-test) of hypoactive delirium and delirium patients in the control group who received normal standard nursing care
- Phase 2: Intervention group: Assessment (pre and post-test) of hypoactive delirium and delirium patients who received non-pharmacological interventions.
- Before phase 1 Intensive care nurses (ICU) was trained on hypoactive delirium, delirium and the ICDSC screening tool and before phase 2 ICU nurses was trained on non-pharmacological interventions and ICDSC screening. (See Annexure D1-D6).

In table 4.1 below a summary follows of the amount of ICU nurses who were trained on hypoactive delirium, delirium and ICDSC checklist. They consisted of Professional nurses trained in ICU, Professional nurses ICU Experience In ICU and Enrolled nurses.

Table 4.1 ICU nurses training session before phase 1

TOPIC: • Hypoactive delirium In ICU patients • The ICDSC score	**Number of ICU nurses trained in Phase 1**
PN Trained ICU	19
PN Experienced ICU	16
EN	2
	TOTAL 37

In the table 4.2 below a summary follows of the amount of ICU nurses who were trained on non-pharmacological interventions and ICDSC checklist. They consisted of Professional nurses trained in ICU, Professional nurses having experience In ICU and Enrolled nurses.

Table 4.2 ICU nurse straining session before phase 2

TOPIC: • Non-pharmacological interventions • The ICDSC score	**Number of ICU nurses trained in Phase 2**
PN Trained ICU	20
PN Experienced ICU	18
EN	2
	TOTAL 40

4.4 PRE-OPERATIVE RISK FACTORS

The control and interventions groups were screened with a pre-operative checklist for risk factors (see Annexure D2). Table 4.3 summarises the pre-operative risk factors in both control and intervention groups. The following risk factors were included in the screening of participant because risk factors increased the changes for hypoactive delirium and delirium development and were divided into modifiable and non-modifiable risk factors. (Hsieh, Shum, Lee, Hasselmark et al 2015:496; Vasilevskis et al 2012:287). Modifiable risk factors were identified because it should be limited in the post-operative period to lower the incidence of developing hypoactive delirium and delirium. (Hsieh, Shum, Lee, Hasselmark et al 2015:496; Vasilevskis et al 2012:287). See 2.5 for discussion on risk factors and the significance.

Table 4.3 Pre-operative risk factors between control and intervention group

	Control group n=30		**Intervention group n=30**		**Analysis of variance**	
Pre-operative risks	**Number**	**%**	**Number**	**%**	**F test**	**p value**
Female	9	29.03	11	35.48	11.11	
Male	22	70.97	22	70.97		
History of sleep meds	13	41.94	10	32.26	0.93	0.34
History of pain meds usage	10	32.26	12	38.71	0.12	0.73
History of alcohol usages daily	10	32.26	16	51.61	0.13	0.72

	Control group n=30	Intervention group n=30	Analysis of variance	3.23		
Pre-operative risks	**Number**	**%**	**Number**	**%**	**F test**	**p value**
Elevated liver function	1	3.23	2	6.45	0.03	0.85
Peripheral vascular disease	2	6.45	4	12.90	21	0.65
Smoking	13	41.94	15	48.39	0.65	0.42
Atrial Fibrillation	9	29.03	12	38.71	2.24	0.14
Hypertension	27	87.10	25	80.65	1.57	0.21
Diabetes Mellitus	13	41.94	15	48.39	0.1	0.74
Renal impairment	3	9.68	14	45.16	0.8	0.38
IABP pre-operative	1	3.23	3	9.68	0.06	0.79
Heart-failure	9	29.03	10	32.26	0.26	0.60

The results show that of the participants in the control group, 29% (n=9) were female while 71% (n=22) were male. In the intervention group, 35% (n=11) were female and 71% (n=22) were male. See Table 4.4 for modifiable and non-modifiable risk factors for delirium. Pre-operative risk factors can be divided into non-modifiable risk factors and post-operative risk factors as modifiable risk factors. Modifiable risks factors increase patients' risk for developing hypoactive delirium or delirium. age is a non-modifiable risk factor for delirium occurrence (Norkiene et al 2007:184; Hori, Brown, Ono, Rappold et al 2014:1012), where modifiable risk factors should be identified and limited by the implementation of non-pharmacological and pharmacological interventions (Rivosecchi, Smithburger, Svec, Campbell et al 2015:47). Non-modifiable risk factors should be known beforehand to be treated early for delirium prevention strategies although non-modifiable risk factors cannot be changed, only the risk for delirium development can be lower (Rivosecchi et al 2015:47). As indicated in table 4.4 the modifiable and non-modifiable risk factors in both control and intervention group were similar to which was investigated in this research study.

Table 4.4 Modifiable and non-modifiable risk factors for all types of delirium development

Modifiable causes of delirium	Non-modifiable causes of delirium
• Alcohol withdrawal syndrome: (Awassi, Lebrun, Coursin et al 2013:22). • Alcohol abuse, use of sedatives, trauma admission and age >65 years was seen as the strongest predictors of delirium development (Kanova et al 2017:192). • Nicotine withdrawal syndrome (Hsieh et al 2013:502; Honisett 2001:321; Awassi et al 2013:58) • Sedation and opioid withdrawal: (Barr, Kishman& Roman 2013:9). • Intensive care environment: (Zaal, Spruyt, Peelen& Van Eijk 2013:481; Curaso, Guardian, Tiengo et al 2014:2204) and modifiable causes of delirium in the environment include sedation, immobilization, pain, disorientation and sleep deprivation (Hsieh et al 2013:497).	• History of dementia (Hshieh et al 2013:496;Devlin et al 2015:45) Co-morbidities (Hshieh et al 2013:496) • Poor health (Vasilevskis et al 2012:287) • Multi-organ failure (Vasilevskis et al 2012:287; Sanjay, 2014:164) • One recent surgery (Vasilevskis et al 2012:287) • Hypertension (Zaal et al 2015:45) • Poly-trauma (Zaal et al 2015:45) • Emergency Surgery (Zaal et al 2015:45) • Mechanical ventilation (Zaal et al 2015:45) • Metabolic acidosis (Zaal et al 2015:45)
• Opioid and sedation usage: (Patel, Poston, Pohlman, Hall, et al 2014:1443; Awassi et al 2013:59)	
• Chemical and physical restraints (Sullah et al 2010:210). • Change in sedation protocols (Hughes, Brummel, Vasilevskis et al 2012:402; Ely 2002:5). • Physical restraints (Mehta, Cook, Devlin, Skrobik et al 2015:565;McPherson et al 2013:408) restraining lines, intra-aortic balloon bump, ventricular assist devices that inhibit mobilization especially cardio-thoracic patients with catheters (McPherson et al 2013:408).	
• Post-operative delirium: (Flinn, Diehl, Seyfried&Malani 2009:268).	

No significant difference was found among post-operative risk factors. The control and intervention groups' age analysis were assessed because age >65 years is an independent and the strongest predictor for delirium occurrence and should be noted (Kanova et al 2017:192; Mistraletti et al 2012:321). For this reason the age analysis is discussed in Table 4.5 and participants above 65 years were analysed to assess if age contributed to delirium occurrence.

Table 4.5 Age analysis below and above 65 years

Age analysis of participants	**Control group**	**Intervention group**
Mean	64.3	61.1
Variance	98.146237	134.1195402
Observations	30	30
Hypothesized Mean Difference	0	
Df	57	
t Stat	1.1424084	
P(T<=t) one-tail	0.1290302	
t Critical one-tail	1.6720289	
P(T<=t) two-tail	0.2580604	
t Critical two-tail	2.0024655	

Table 4.5 indicates that the mean age was 64,3 years for the control group and 61,1 years for the intervention group. This resulted in a p value of 0,2580604 which indicated a significant difference in age analysis between the control and intervention groups. This indicates in this study that increase age could increase delirium occupancy which correlates with research done by Kanova et al 2017:192; Mistraletti et al 2012:321 that age >65 years was seen as the strongest predictor of delirium development.

The following post-operative risk factors were assessed in both groups to determine similarity. Table 4.6 summarizes the post-operative risk factors in the control and intervention groups which are modifiable risk factors stipulated in Table 4.4.

Table 4.6 Post-operative risk factors for delirium development

	Control group		Intervention group		Analysis of variance	
Post-operative risk factors	**Number**	**%**	**Number**	**%**	**F test**	**p value**
Saturation above 90%	30	100.00	30	100.00		
Sleeping tablets	0	0.00	1	3.23		
Systolic blood pressure >90mmHg	30	100.00	30	100.00		
Inotropic use	30	100.00	30	100.00		
Metabolic acidosis	11	35.48	14	45.16	0.9	0.34

As reflected in Table 4.6, the post-operative risk factors were similar in both the control and intervention groups, with the exception of metabolic acidosis which had a p value of 0,34 which resulted to the conclusion that metabolic acidosis could increase the risk for hypoactive delirium and delirium development. This was stipulated by Mistraletti et al (2012:321) which stated that post-operative risk factors is a huge contributing factor to delirium development and these should be monitored and the severity of the above-mentioned risk factors should be limited. These risk factors identify vulnerable patients and early detection and treatment of hypoactive delirium and delirium is essential (Shadvar, Baastani, Mahmoodpoor & Bilehjani 2013:158). See Table 4.4 for modifiable and non-modifiable risk factors for all delirium types development. Table 4.7 lists the analgesia and sedation used in ICU to indicate the similarity between the two groups, because analgesia and sedation is a modifiable risk factor for all types of delirium development as stipulated in table 4.4. All participants in the study received the sedation and analgesia as part of a post-operative pain control regime which is part of modifiable risk factors to develop any type of delirium. The sedation was stopped on day 1, two hours prior ICDSC screening. Analgesia continued until participants were discharged out of the ICU unit.

Table 4.7 Analgesia and sedation use in ICU

	Control group		Intervention group		Analysis of variance	
Analgesia in ICU	**Frequency**	**%**	**Frequency**	**%**	**F test**	**p value**
PCA pump: Precedex®, Sufenta®,Kytril® mixture	20	64.52	17	54.84	1.56	0.22
Morphine® infusion 5-8ml/h	11	35.48	17	54.84	1.56	0.22
Pethidine® 50-100mg imi 6h	17	54.84	21	67.74	0.0005	0.98
Perfalgan® 1gr ivi 6h	19	61.29	15	48.39	2.17	0.15
DF 118® 30mg po 6h	2	6.45	1	3.23		
Precedex(Dexmedetomidine®) infusion 5-15ml/h	1	3.23	1	3.23		
Temgesic® 0,2-0,4mg sl 6h	6	19.35	7	22.58	1.4	0.24
Stilpane® 2tabs 6h	17	54.84	17	54.84	0.02	0.87

Table 4.7 indicates that the type of sedation and analgesia used between the control group and the intervention group did not differ significantly. Most ICU patients need sedation, analgesia, opioids, benzodiazepine, hypnotics, and antipsychotics to facilitate ventilation in order to prevent respiratory depression, hypotension and renal failure (Balas, Vasilevskis, Burke, Boehm et al 2012:36). The risk increases for delirium development with benzodiazepine (Midazolam) treatment as sedation (Balas et al 2012:36). Sullah 2010:210 also state that invasive lines and Midazolam sedation contribute to delirium incidence and is a modifiable risk factor that should be addressed. Hsieh et al (2013:497) identified sedation, pain and immobilization as modifiable risk factors of delirium which if addressed, delirium incidence could be lowered. Opioid and sedation medication can increase delirium in ICU because it alters the mental status (Pattel et al 2014:663) and should be adjusted daily because it accumulate and sedation vacation withdrawal symptoms can appear (Awassi et al 2013:59). This was achieved in the study where the patients were assessed 2 hours post extubation where the sedation was stopped as part of extubation criteria. Table 4.8 indicates when sedation was stopped in ICU. Sedation had to be stopped a minimum of two hours prior to ICDSC screening and post-extubation. Hypoactive

delirium is different from reversible sedation-related delirium and the prognosis of sedation related delirium is better than hypoactive delirium (Patel, Poston, Pohlman, Hall et al 2014:664).

Table 4.8 Sedation in ICU stopped on day 1: 2 hours prior to first pre-test screening with ICDSC checklist

	Control group		**Intervention group**		**Analysis of variance**	
Sedation in ICU stopped day 1	Frequency	%	Frequency	%	F test	p value
Diprivan® (Propofol) infusion 5-10ml/h ON DAY 0	29	93.55	30	100.00	0.06	0.80
Dormicum® (Midazolam) 2-3mg/h ivi ON DAY 0	24	77.42	26	83.87	0.139	0.71

In Table 4.8 it is specified when the sedation was stopped in ICU as per recommendations from ICDSC checklist before respondent can be screened for hypoactive deliriums and delirium. It is seen that there was no significant difference between the control and intervention group about how the sedation was stopped. It was stopped in similar manner in both groups. Sedation should be stopped for more than 2 hours before delirium assessment should be done (Pattel et al 2014:664) and this was achieved in this study. Maintaining a light level of sedation but good analgesia ensures that the clinical outcomes of ICU are better (Barr, Pandharipande 2013:109). Sedation and analgesia administered was measured because a fluctuation in sedation levels may cause delirium (Svenningsen, Egerod, Videbech, Christensen, et al. 2013:292) and change in sedation protocols can improve brain dysfunction, thus delirium assessment tools should be promoted and adopted in ICU setting (Hughes et al 2012:402). The Richmond agitation score was done to assess sedation and the Glascow coma scale was assessed with best motor, verbal and sensory function which is part of normal ICU nursing care. With surgical patients the risk for delirium can be limited due to less surgical techniques, decreased surgical duration, avoid blood transfusion if can, avoid Benzodiazepine use as sedation (Vasilevskis, 2012:283). The population was surgical patients in this study. The

more sedation and analgesia administered (6 or more drugs a day) especially in the elderly, it is an independent risk factor for occurrence of any type of delirium after emergency admission in ICU (Hein, Forgues,Piau, Sommet et al. 2014:850) and table 4.5 describe the age analysis of the population group used.. In Section 4.5 the discussion of the prevalence of hypoactive delirium and delirium in both the control and intervention group will follow.

4.5 HYPOACTIVE DELIRIUM AND DELIRIUM PREVELANCE

Prevalence indicates the number of cases at any given point in time to the number of the population at risk where incidence investigates the number of new cases at any given point in time over the number in the population at risk (Bothma, Greeff, Mulaudzi & Wright 2010:44*).* The prevalence data is generated by the control group incidence (by pre-test scoring) and duration of hypoactive delirium without any intervention. The prevalence of hypoactive delirium and delirium was assessed utilizing the ICDSC screening checklist at 8:00 on the participants in both control and intervention groups. Classification on the ICDSC refers to levels of hypoactive delirium and delirium where a score of 0 means normal, a score of 1-3 means hypoactive delirium and a score of 4-8 means delirium. A validated screening tool should be used to identify hypoactive delirium or delirium (Neufeld, Nelliot, Inouye, Ely et al 2014:1513; Brown, Lamflam, Max, Lymar et al 2016:1663; Jones & Pisani 2012:146; Gunther 2012:2032). A study on the predictors, prevalence and detection of delirium in an adult hospital intensive care unit population found that approximately 20% of all patients experience delirium at some point in their hospital stay (Ryan, O'Regan, Caiomh, Clare et al 2015:6).

4.5.1 Control group

All the participants (100%; n=30) in the control group were screened for the prevalence of hypoactive delirium or delirium @ 8:00 on day 1 following extubation. Table 4.9 presents a summary of the prevalence of hypoactive delirium and delirium for the control group. Before this study was conducted, there was no record of what the prevalence of hypoactive delirium and delirium is in this specific ICU unit where the study was conducted.

Table 4.9 Prevalence of hypoactive delirium and delirium in the control group

Type of delirium	Delirium category (ICDSC score)	Frequency	Percentage%
Hypoactive delirium	1	0	0
	2	1	3
	3	2	6
Delirium	4	7	23
	5	8	26
	6	10	32
	7	3	10
	8	0	0
	Total	30	100

Table 4.9 indicates that of the participants, 9% (n=3) presented with hypoactive delirium and 91% (n=28) presented with delirium at the onset of the study. None of the respondents presented with no delirium at the onset of the study at 8:00 on day 1 following extubation.

The prevalence of delirium concurred with Barr et al (2013:282) and McPherson et al (2013:408) findings were that delirium can occur in up to 50% of intensive care patients and hypoactive delirium can occur in up to 75% of cases which will be unrecognized if no screening tool is utilized.

4.5.2 Intervention group

All the participants (100%; n=30) in the intervention group were screened for the prevalence of hypoactive delirium or delirium @ 8:00 on day 1 following extubation. Table 4.10 presents a summary of the prevalence of hypoactive delirium and delirium for the intervention group.

Table 4.10 Prevalence of hypoactive delirium and delirium in the intervention group

Type of delirium	Delirium category (ICDSC score)	Frequency	Percentage %
Hypoactive delirium	1	0	0
	2	0	0
	3	2	7
Delirium	4	9	30
	5	9	30
	6	8	27
	7	2	7
	8	0	0
	Total	30	100

Table 4.10 indicates that of the participants, 7% (n=2) presented with hypoactive delirium at the onset of the study with the first pre-test screening done at 8:00 with the ICDSC screening tool and 94% (n=28) presented with delirium at 8:00 on day 1 following extubation.

The prevalence of delirium and hypoactive delirium classification was similar in the control and intervention groups at the onset of the study, indicating the baseline data for both groups were similar. An international study on delirium epidemiology in critical care units found a 32% delirium prevalence in general ICU patients and the diagnosis of delirium was associated with worst outcomes, including longer ICU stay, and independently associated with short-term mortality (Salluh, Soares, Teles, Ceraso et al 2010:210). The researcher found no South African data from any delirium prevalence in ICU or prevention programmes in ICU.

4.6 SEVERITY OF HYPOACTIVE DELIRIUM AND DELIRIUM

The ICDSC checklist classifies severity of delirium as a score between 0-8. A score of 0 indicates no delirium; a score of 1-3 indicates hypoactive delirium, and a score of 4-8 indicates delirium. The severity of the participants in both the control and intervention groups improved to an ideal score of 0, which indicated that all improved to a state of no delirium. However, the duration to achieve a score of 0 indicating no

delirium differed between the control and intervention groups and is discussed in the next section.

4.7 DURATION OF HYPOACTIVE DELIRIUM AND DELIRIUM

The duration of hypoactive delirium and delirium was measured by converting days into hours from hypoactive delirium and delirium to no delirium scoring by utilizing the ICDSC screening tool. The duration in hours of participants to a score of 0 (no delirium) in the intervention group was shorter (less) than of the participants in the control group to convert to a score of 0 (no delirium). The conclusion was thus that the improvement duration of participants in the intervention group to convert to a score of 0 was a result of the implementation of non-pharmacological interventions in the intervention group.

4.7.1 Duration of hypoactive delirium to no delirium

Table 4.11 indicates the duration of hypoactive delirium measured in hours that it took for each group to reach no delirium. For participants, the ICDSC score needed to improve from 1-3 (hypoactive delirium) to a score of 0 (no delirium).

Table 4.11 Duration of total hours' hypoactive delirium to no delirium

	Control (n=29)	**Intervention (n=27)**	**p-value**
	Mean (SD)	**Mean (SD)**	
Duration (hours)	50.5 (2.7)	47.1 (2.9)	0.40

Table 4.11 indicates that the duration of hypoactive delirium in the control group to a score of 0 (no delirium) took 50,5 hours versus the intervention group which took 47,1 hours to reach a score of 0 (no delirium).

Although the intervention group took a shorter time (duration) to reach no delirium state from a hypoactive delirium state versus the control group, the difference was not significant with a p=0,40. Delirium and especially hypoactive delirium are frequently missed in ICU units which results in increased length of stay in the ICU

and increased financial implications for patients and therefor a validated screening tool should be used to identify specifically hypoactive delirium (Neufeld, Nelliot, Inouye, Ely et al 2014:5; Brown, Lamflam, Max, Lymar et al 2016:1663).

4.7.2 Duration of delirium to no delirium

The participants' duration of delirium in both groups was measured in hours to reach a state of no delirium. This meant time it took for the participants' ICDSC score to improve from between 4-8 (delirium) to a score of 0 (no delirium). Table 4.10 indicates the duration from delirium to no delirium.

Table 4.12 Duration in total hours from delirium to no delirium

	Control (n=31)	**Intervention (n=29)**	**p-value**
	Mean (SD)	**Mean (SD)**	
Duration (hours)	72.3 (3.0)	62.4 (3.0)	0.02

Table 4.12 indicates that to improve from delirium to no delirium took 72,3 hours in the control group versus 62,4 hours in the intervention group which is a significant difference in duration from delirium to no delirium. Tovar et al (2016:68-71) used a pre-post-test design to screen for delirium and implemented non-pharmacological interventions for 5 days and found a 94% improvement in delirium occurrence between pre-test and post-test data in 5 days.

The non-pharmacological interventions used in this study are discussed next.

4.8 NON-PHARMACOLOGICAL INTERVENTIONS

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The study found that the implementation of non-pharmacological interventions reduced the severity and duration of delirium among the participants in the intervention group compared to those in the control group. This finding concurred with those of Ely (2002:1-32); Martinez et al (2012:630); Rivosecchi et al (2015:47) and Shaughnessy (2002:1475). The non-pharmacological interventions consisted of

three aspects, namely improving communication between ICU team members, standardising delirium care prevention, and limiting as well as breaking the cycle of over sedation and prolonged mechanical ventilation that could lead to delirium (Balas et al 2012:45).

In order to prevent delirium, ICU nurses were trained before phase 1 and 2. See Table 4.1 and 4.2 for training topics. Training is important because it teaches the ICU nurses how to promote weaning off sedation, early mobilization, sedation vacation and extubation that would decrease ventilator days and risk for delirium (Balas 2012:46; Hughes et al 2012:402).

A meta-analysis of non-pharmacological interventions found that orientation, early mobilization, hearing aids and vision aids, sleeping aids and hydration were the most important non-pharmacological interventions (Hshieh, Yue, Oh, Puelle et al 2015:516-519). Hshieh, Yue, Oh, Puelle et al (2015:516-519) reported a 53% reduction of delirium in an intervention group of 3,751 patients.

Mistraletti, Pelosi, Mantovani et al (2012:321) emphasise the following non-pharmacological interventions to assist patients with reorientation: involving the family with neurological monitoring; having specific handover meetings about delirium prevention; training staff about validated tools; using familiar visual and auditory media from patients' homes in hospital, like watches and calendars, placing pictures of family in the room, calling patients by name and allowing them to read newspapers; turning patients' beds to orientate about daylight/darkness, and scheduling informational interviews with ICU staff about diagnostic and therapeutic measures.

In this study, the non-pharmacological interventions implemented (Ely 2002:1-32; Martinez et al 2012:630; Rivosecchi et al 2015:47) included providing visual and hearing aids; encouraging communication and reorientation hourly; having family objects from home around the ICU beds; allowing television or radio use; trying to have consistent nursing staff, and playing classical music (see Annexure D4).

4.8.1 Provide visual and hearing aids (Glasses)

This was implemented by asking patients pre-operatively if they wore glasses/contact lenses/hearing aids and ensuring that these were in the ICU when the patients woke up. These were provided as soon as patients aroused from anaesthesia.

Atalan et al (2013:936) maintain that patients must use their glasses and hearing aids and nurses should focus on early correction of dehydration, use of pain medication, placing familiar objects around the bed, have a clock where patients can see it, have calendars in the room, and minimize noise and stimuli. Hshieh et al (2015:516-519) emphasise cognition stimulation or orientation, early mobilization, hearing, sleep-wake cycle, vision and hydration as non-pharmacological interventions.

4.8.2 Encourage communication and reorientation hourly

This was done hourly if the patients were awake by ICU bedside nurses. Patients were orientated about day/night, what operation was done and what would be following in the next hour of nursing care. A calendar was placed at the bedside indicating the month, the day as well as the number of the day 1-5 admitted. An alarm clock was provided at the patient's bedside to orientate about time (Abraha, Trotta, Rimland, Cruz-Jentoft et al 2015:13).

The prevention and treatment of risk factors by means of cognitive stimulation and reorientation have the greatest benefit in minimizing delirium and reorientation hourly with the use of familiar voice recordings can be helpful (Rivosecchi et al 2015:47; Atalan et al 2013:936; Munro et al 2017:5). Orientation programmes have also been found beneficial in delirium prevention (Abraha et al 2015:13; Munro et al 2016:5; Hshieh et al 2015:516-5; Martinez et al 2015:198; Smith & Grami 2017:23-26).

4.8.3 Have family objects from home around ICU bed

The participants' families were asked to email family photos which were printed and were visible around a patient's bed the whole time. They were attached to the nurse's writing table so that the patient could see their family whether lying down or sitting in the chair. The ICU bedside nurse also talked to the patient about the family and where the pictures were taken for reorientation. Participants took the family photos to

the ward as well which further helped to motivate them further (Abraha et al 2015:13).

4.8.4 Attempt consistent nursing staff

The rationale was that the most ICU nurses working in the specific unit were trained in delirium screening and the implementation of non-pharmacological interventions. To assure consistent staff meant that nurses were not allocated to patients if they had not been trained about delirium. Some nurses nursed a patient more than one day continuously which meant good continuous implementation of non-pharmacological interventions.

Staff education programmes, in-service training and an informed multi-disciplinary team are important factors in delirium prevention (Abraha et al 2015:13; Martinez et al 2015:198).

4.8.5 Allow television/radio use

Unfortunately there was only one radio available for use. There were no television for the participants to watch, so that resulted in a limitation and a suggestion to management was made on the recommendation of the outcome of the study to improve radio and television availability in the ICU units. The researcher did not allow participants to bring own televisions or radio's for the fear that it could be stolen or lost. The researcher provided one radio in the middle of the unit and played classical music softly during the sleeping hour that will be discussed in section 4.8.7.

Regarding prevention and treatment of risk factors, cognitive stimulation and reorientation have the greatest benefit in minimizing delirium (Rivosecchi et al 2015:47; Atalan et al 2013:936; Abraha et al 2015:13; Smith & Grami 2017:23-26). Martinez et al (2015:198) stress that sensory deprivation should be avoided to reduce the occurrence of delirium.

4.8.6 Non-verbal music (Classical)

Music is not only important for cognitive stimulation, but also soothes pain, improves moods, reduces anxiety and encourages relaxation (Abraha et al 2015:13; Rivosecchi et al 2015:47; Atalan et al 2013:936; Smith & Grami 2017:23-26; Martinez et al

2015:198). This was achieved in the study by playing classical music on one radio softly in the middle of the ICU unit during the sleeping hour.

4.8.7 Sleep hygiene: lights off in ICU 14:00-15:00

The lights were switched off during this period and visitors and unnecessary doctors or physiotherapist rounds were limited. The blinds of the windows were closed and all the patients were put back into the bed after mobilization to sleep for an hour. Noise control was important to implement in this hour, because the patients did not want to use the earplugs provided to each patient. They said they feel unsafe if they can't hear or see (eye masks).

Hshieh et al (2015:516-519); Flannery, Oyler and Weinhouse (2016:2230-2240); Hayhurst, Pandharipande and Hughes (2016:1235), and Smith and Grami (2017:23-26) emphasise the importance of sleep hygiene and creating an ICU environment where patients can sleep. The repetitive provision of cognitive stimulation activities, sleep protocols, maintenance of day and night sleep, range of motion exercise with early mobilization, reduction of physical restraints and removal of invasive devices encourage sleep hygiene and reduce or prevent delirium (Hshieh et al 2015:516-519). Sleeping in the ICU with earplugs resulted in fewer patients developing delirium or confusion and the onset of cognitive disturbance was delayed compared to patients who did not sleep with earplugs (Van Rompaey 2012:9). The use of earplugs, eye masks, tranquil music, relaxation techniques, fewer night time awakenings, longer sleep duration at night and back massages were found to significantly improve cognitive impairment, while perceived noise ratings and improved sleep resulted in lower delirium scores (Kamdar, Kamdar & Needham 2014:528; Hayhurst, Pandharipande & Hughes 2016:1235). Mistraletti et al (2012:321) maintain that in the ICU nurses should promote nocturnal sleep, discourage daytime sleep and supplement with melatonin. Sleep deprivation is associated with delirium incidence but the cause-and-effect is not clear and the use of sedation medication changes the sleep pattern and decreases rapid eye movement (REM) sleep (Watson, Ceriana & Fanfulla 2012:363).

4.8.8 Control access noise

Throughout the study the nurses were made aware of noise with posters stating "please be quiet" and a noise controller, usually the researcher or the shift leader on duty was appointed every day. It is difficult to control noise in a South African ICU because African people do not talk softly as part of their culture. Less care-related interruptions were indicated to be important, which entailed appropriate lighting, noise reduction, clustering night time activities so that the patients could sleep from 23:00- to 5:00, optimizing comfort with adequate temperature in the room, bathing at 20:00 and not 14:00, and changing the mattresses to inflatable ones to improve sleep and lessen discomfort (Bush, Grassau, Yarmo, Zhang et al 2017:83). Kamdar, Kamdar and Needham (2014:528) point out the importance of a quiet ICU environment that is conducive to sleep. Cardiac surgical patients commonly experience post-operative delirium which results in increased mortality, morbidity, and a higher prevalence of sternum instability and prolonged ICU length of stay (Trabold & Metterlein 2014:17). Early detection is necessary and hypoactive delirium is frequently missed (Trabold & Metterlein 2014:17). The reduction of noise and continuous artificial lighting lowered impaired sleep from 84% to 24% (Tovar et al 2016:68-71).

4.8.9 Cognitive stimulation

Cognitive stimulation is important to improve and maintain cognitive function. (Ely 2002:1-32; Martinez et al 2012:630; Rivosecchi et al 2015:47; Shaughnessy 2002:1475). This was done with a 24 piece puzzle that participants had to complete once a day. Every day was a different puzzle so that each participant do not complete the same puzzle twice. This was done during the time the participants mobilized to the chair. It was difficult on day 1 for participants to complete even a 24 piece puzzle due to lack of concentration and effect of analgesia. On day 2 participants could concentrate better with a 24 piece puzzle.

4.8.10 Mobilize patients twice daily

Participants was mobilized at 8:00 and again at 12:00 or 16:00 because early mobilization, noise reduction and sleep protocols have a benefit in reducing delirium (Rivosecchi et al 2015:47; Smith & Grami 2017:23-26; Hshieh et al 2015:516-519). Mobilization can be full mobilization or passive movements and nurses must advocate early removal of intravenous lines and catheters that inhibit mobilization (Rivosecchi et al 2015:47; Mistraletti et al 2012:321).

4.8.11 Physical restrains usage prohibited

In the training sessions provided stipulated in table 4.1 and 4.2, the reason was given to the ICU nurses why physical restrains is not conducive to the ICU patient and could increase the incidence of all types of delirium occurrence. Physical hand restraints were not used during the research project. ICU nurses also did not realize that chemical restraints also have a influence on delirium occurrence.

One out of four cardiac surgery patients develop hypoactive delirium and delirium due to increased Benzodiazepine and physical restraints used (McPherson et al 2013:410). Chemical and physical restraints and invasive lines were found to increase delirium and a potentially modifiable risk factor (Sullah et al 2010:210). Physical restraints increased the prevalence of delirium (Mehta, Cook, Devlin, Skrobik et al 2015:565; McPherson et al 2013:408) and restraining lines, devices like intra-aortic balloon bump and ventricular assist devices inhibit mobilization especially among cardio-thoracic patients with catheters (McPherson et al 2013:408). Atalan et al (2013:936) emphasise the repetitive provision of cognitive stimulation activities, sleep protocols, maintenance of day and night sleep, a range of motion exercises with early mobilization, the reduction of physical restraints and removal of invasive devices. Smith and Grami (2017:23-26) found that physical restraints significantly increased the chances for delirium.

4.8.12 Sedation weaning/stopped

Sedation was stopped as stipulated in table 4.8. A nurse was trained in the training sessions in table 4.1 and 4.2 why it is important to stop sedation early.

Changing sedation levels are associated with delirium and a stable sedation level or non-sedation is recommended to limit the incidence of delirium (Svenningsen et al 2013:292). Sedation and analgesia make delirium worse (Balas et al 2012:36) and sedation cessation is necessary to prevent delirium (Smith & Grami 2017:23-26; Schweickert, Pohlman, Nigos, Pawlik et al 2009:1874-1882). Sedation and analgesia are important in ICU treatment to assure better mechanical ventilation, improve tolerance of invasive procedures and prevent patient agitation and aggression by using benzodiazepine (Balas et al 2012:36; Sullah et al 2010:210).

4.8.13 Invasive lines in sito

Invasive lines were removed according to doctors' orders. Usually on day 3 the urinary catheter, intercostal drains and arterial line were removed. On day 4 usually the central venous line was removed. Invasive lines also fall under physical restrains that can increase delirium occurrence as mentioned above in section 4.8.11. In the training sessions nurses did not relize that invasive lines falls under the category of physical restraints which influence the patient delirium state. Invasive lines could not be removed earlier in the study, because the population, cardio-thoracic patients, need invasive lines for monitoring and administration of medication. In the training sessions the researcher taught ICU nurses to "hide" the invasive lines with a pillow case so that the patient do not feel so restricted in the bed. This is also the reason the patients felt they did not want to use earplugs or eye masks (sleep hygiene) because they already felt that they are restricted in the bed with invasive lines and do not have any control over their own body.

Vital observation is necessary to prevent delirium which entails correcting hypoxia, improving hypo/hypertension, correcting anaemia and cardiac arrhythmias all of which can lead to organ failure (Mistraletti et al 2012:321). These observations were monitored on each patient continuously as normal procedure in the ICU unit. Further observations included adequate enteral hydration, encouraging an adequate calorie intake, trace elements and vitamins intake, use of dentures if necessary, facilitating intestinal bowel movement, avoiding unnecessary drug treatment, especially neuro-active drugs, providing deep vein thrombosis prophylaxis, using physical restraints

only if necessary and maintaining a normal Ph balance (Mistraletti et al 2012:321).

4.9 CONCLUSION

This chapter discussed the data analysis and interpretation and results. The control and intervention group participants were similar in terms of pre- and post-operative risk factors, sedation and analgesia usage. The only significant difference was standard nursing care rendered to the control group versus implementation of non-pharmacological interventions for the intervention group. Tables 4.11 and 4.12 indicate that the duration in hours from delirium to no delirium in the intervention group was significantly shorter than in the control group and therefore support the effect of non-pharmacological interventions on the improvement of hypoactive delirium and delirium in post-operative cardio-thoracic patients.

Chapter 5 describes the limitations of the study and makes recommendations for practice and further research.

CHAPTER 5 CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 4 discussed the data analysis and interpretation, and the findings. This chapter concludes the study, briefly describes its limitations and makes recommendations for practice and further research.

5.2 AIM AND OBJECTIVES OF THE STUDY

The aim of the study was to assess the effect of non-pharmacological interventions on the severity and duration of hypoactive delirium and delirium in ICU patients following cardio-thoracic surgery. In order to achieve the aim, the objectives were to assess

- The prevalence of hypoactive delirium and delirium during pre-test scoring with the ICDSC tool (08:00) on post-operative cardio-thoracic patients.
- The effect of implementation of non-pharmacological interventions nursing care versus normal standard nursing care on the severity and duration of hypoactive delirium and delirium (in hours) in ICU patients following cardio-thoracic surgery.

5.3 CONCLUSION

The participants were all post-cardio-thoracic surgery patients admitted in the selected cardio-thoracic unit who met the inclusion criteria and agreed to participate. The composition of the control and intervention groups was similar in terms of pre- and post-operative risk factors, sedation and analgesia usage. The only significant difference was standard nursing care rendered to the control group versus implementation of non-pharmacological interventions for the intervention

group. The study found that the duration in hours from delirium to no delirium differ from 72,3 hours in the control group to 62,4 hours in the intervention group which was a significantly shorter duration than in the intervention group (see chapter 4, Table 4.11 and 4.12). This therefore supports the effect of non-pharmacological interventions on the improvement of delirium in post-operative cardio-thoracic patients. There were no significantly changes in duration from hypoactive delirium to no delirium between the control and intervention group.

The reflection on the hypothesis it the following:

- The hypothesis that non-pharmacological interventions would reduce the severity and duration on hypoactive delirium is rejected
- The hypothesis that non-pharmacological interventions would reduce the severity and duration on delirium is accepted.

5.4 LIMITATIONS

The study was only done in one Intensive care unit, in one private hospital with a small sample group and only cardio-thoracic patients. The study could be done in a multi-ICU on a bigger scale with a bigger sample in private and provincial hospitals. The participants were not randomized due to the layout of the unit which resulted in a methodology limitation. The non-pharmacological interventions were only implemented during the day when the researcher was present and not during the night. There was only one radio available to use and no television was available. See section 3.5 for limitation discussion.

5.5 RECOMMENDATIONS

Based on the findings the researcher makes the following recommendations for practice and further research.

5.5.1 Nursing managers

Delirium prevention programmes should be part of normal daily nursing care in Intensive care units. Nursing managers should drive these programmes, make staff aware of all types of delirium among ICU patients and implement a delirium prevention programme. Nursing managers should advocate for the patient during doctors' rounds for sedation and analgesia weaning. Delirium prevention programmes are a multi-disciplinary team approach and the nursing managers should be the programme drivers and implement non-pharmacological interventions in the ICU units. DVD players, radio and televisions are good non-pharmacological interventions to stimulate patients' cognitive function. In most ICU's, however, these items are not available for patient use.

5.5.2 Nursing educators

Delirium pathophysiology, all types of delirium, delirium prevention and delirium treatment should be part of the nursing curriculum for basic students and ICU students in nursing training institutions. Delirium can occur in any area in a hospital, not necessarily or solely among ICU patients. All nursing staff should be trained to screen for delirium, to implement delirium prevention strategies and what the complications are when delirium occurs. At hospital level in-service training should be done with all hospital staff on how to screen for delirium, the types of delirium, delirium prevention and implementation of non-pharmacological interventions as part of daily nursing care. Ongoing prevention programmes should be implemented and driven by nursing educators. In addition, delirium care campaigns should be introduced in hospitals and students should be utilized to create awareness among nursing staff.

5.5.3 Nursing practice

Bedside nurses are the ones who are constantly at the patients' bedside. They interact with the patients throughout the day by delivering nursing care and talking to them and the family. They are in a perfect position to see if patients become delirious and screen patients for delirium during the day. The bedside nurses should be trained to screen patients for delirium and implement non-pharmacological interventions throughout the day. They should know exactly what non-pharmacological interventions entail and implement these as part of their daily ICU care. Reorientation should be done hourly about the day, time and month; what procedure was done; day/night, and what the patient can expect in the next hour regarding nursing care. Family photos should be placed around the bed for cognitive stimulation and motivation as well. Alarm clocks should be visible as well as a calendar at the bedside which is personalized for the patient in the bed indicating when the operation was done and what day it is, such as day 1 or 2. DVD players/radio/television should be used for an hour or two during the day as well for cognitive stimulation. Patients can play educational games like cards, Sudoku or crossword puzzles, or build normal puzzles while they are sitting in the chair twice a day. A sleeping hour during the day is very important and lights should be switched off earlier at night. Patients should get more than four hours' uninterrupted sleep per night because sleep deprivation can lead to delirium. Nurses should be educated about noise control in the ICU because it also worsens sleep deprivation. Earplugs and eye masks should be provided to all ICU patients to use if they cannot sleep due to the lights and noise. During the study, however, only two patients made use of them. Most of the participants felt that they had no power over their bodies anymore except by hearing and seeing. Consequently, they did not want to lose this ability as well, and some said they felt scared or nervous when they could not hear or see in the ICU.

Family members need education about delirium and delirium prevention before their loved one is admitted into an ICU unit, because the incidence of delirium development is high as stipulated in this research document. This can be achieved by including a chapter about

delirium in the pre-admission documents or the information pamphlet about the ICU stay. The ICU nurses can as well include this topic when they assess the patient during their pre-operative visit the day before surgery. Inside the ICU unit posters can help patients and family to adjust to the busy ICU environment and delirium can be one of the information topics on such a poster or information pamphlet.

5.5.4 Further research

Further research should be conducted on the following topics:

- Nurses' perceptions of the implementation and efficacy of non-pharmacological interventions for hypoactive delirium and delirium in post-operative cardio-thoracic surgery patients
- An examination of the effect of interventions to improve sleep on delirium in the ICU
- An investigation into the effect of the ICU architectural design on the prevalence of delirium
- The effectiveness of multi-component non-pharmacological delirium interventions
- Patients perception of implementation of non-pharmacological interventions
- Patients and family members experience of delirium episodes following any surgery
- ICU bedside nurses knowledge defect about delirium and delirium prevention.

5.6 PERSONAL REFLECTION

Delirium care prevention bundles can be implemented in all ICU units nationwide, but this is not done at present. Patients can only benefit by delirium care prevention and awareness campaigns and in-service training of ICU staff is essential. The ICU nurses were not taught about delirium and delirium prevention during formal pre graduate education and training, and this should be included in the ICU curriculum. The participants

in the study enjoyed the non-pharmacological interventions like the photos around the bed very much and it seemed to lead to a more personal level of nursing. The hourly re-orientation of patients forces the ICU nurses to socialize with the patients and the patients enjoyed that a lot. The participants' family members also enjoyed the photos around the bed, because they felt this motivated them to get better sooner. The ICU staff enjoyed the sleeping hour that was implemented during the day from 14:00 to 15:00 because they felt that the patients could then rest before visiting time at 15:00. The patients did not utilize the earplugs and eye masks a lot because they said that they felt out of control most of the time in ICU and the only thing that they could manage themselves was seeing and hearing. When they used the earplugs and eye masks they felt apprehensive and vulnerable. There was only one radio in the unit and no TV to watch. It could benefit patients' mental status if each bed had a radio or a TV or a port for a DVD player was available in the ICU unit. The bed space in ICU should be rearranged so that patients can look out of the window instead of lying with their backs to the window. Information leaflets should be made available to family members whose loved ones are in ICU to teach them about delirium care prevention and how they can assist in limiting delirium by visiting hour conversations. The Intensive care delirium screen checklist (ICDSC) was utilized in this study because the focus was on hypoactive delirium and it differentiates the types of delirium clearly. However, the CAM ICU tool is much easier to use to detect any type of delirium because it only consists of four questions whereas the ICDSC consists of eight questions and looks at the 24-hour period to detect delirium.

5.7 SUMMARY

This study discussed all types of delirium but focused specifically on hypoactive delirium and delirium, because it is not easily identified without utilizing a screening tool. The literature review covered the complications of delirium as well as the treatment for all types of delirium. Treatment can range from pharmacological interventions, which are medications, to non-pharmacological interventions, which are nursing interventions that

are low cost and easy to implement. All nurses, patients and family need to be educated about delirium and delirium care preventions and what that entails in practice. ICU planners should take the layout into consideration to change the bed space so that the patients can have a view out of the window, because most ICU's have the patients' back to the window. DVD players, TVs and radios should be available for use in the ICU to stimulate cognitive function. Nurses should encourage patients to play educational games while mobilized to a chair and the prevention of sleep deprivation is very important. It is my conclusion that the implementation of non-pharmacological interventions will improve the severity and duration on delirium in post-operative cardio-thoracic patients.

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