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**DEVELOPMENT AND IMPLEMENTATION OF LEARNING EVENTS TO
DECREASE THE INCIDENCE OF UNPLANNED EXTUBATION IN A PAEDIATRIC
CRITICAL CARE UNIT**

by

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Declaration

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I, **Seikgato Getrude Molekoa**, declare that **Development and implementation of learning events to decrease the incidence of unplanned extubation in a paediatric critical care unit** is my own work and that all sources that have been used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted for any other degree at any other institution.

Seikgato Getrude Molekoa

Date

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I would like to thank the almighty God for granting me the strength where to complete this research, when we meet challenges of discouragement by others, God always makes a way. We have trust in the Lord at all times. I managed to swim through as he was right there, leading and guiding me every step of the way. He makes the impossible possible.

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Abstract

Introduction: Unplanned extubation is an important quality issue in clinical practice as it is a common occurrence worldwide in the paediatric intensive care units (PICUs). Unplanned extubation of the paediatric patient is a disturbing global phenomenon and it accounts for 3% to 14% incidents per 100 ventilation days in paediatric intensive care units (PICU) in hospitals worldwide. In a PICU where the researcher works as a paediatric critical care nurse the average incidence of unplanned extubation prior to this research was 37% per 100 ventilation days, which is alarmingly higher than the global phenomenon. Paediatric patients are at a particular high risk for unplanned extubation due to their short tracheal length, the use of uncuffed oral endotracheal tubes, and the patient's developmental immaturity which may limit cooperation with healthcare professionals. Unplanned extubation of a paediatric patient is an adverse, avoidable event and therefore studies are needed to establish recommendations to prevent unplanned extubation.

Aim: The overall aim of this study was to collaboratively plan and implement learning events to decrease the incidence of unplanned extubation in a PICU.

Method: During Phase 1, data were collected by means of a clinical audit tool, all mechanically ventilated patients files were audited to determine the incidence and factors contributing to unplanned extubation, in a 7 bedded PICU, from January 2014 to 28 February 2014. The incidences of unplanned extubation were 37% of all mechanically ventilated paediatric patients. During Phase 2 of the study learning events were collaboratively developed with healthcare professionals working in the PICU, to address the identified factors contributing to unplanned extubation. The learning events were implemented for a period of two months, where after during Phase 3 of the study a re-audit of the files of the mechanically ventilated paediatric patient were conducted.

Results: Following the implementations of the learning events for a period of two months the incidence of unplanned extubation of the mechanically ventilated paediatric patients decreased from 37% to 15% in the PICU.

Conclusion: The collaborative development and implementation of learning events to address unplanned extubation in the PICU, raised awareness amongst healthcare professionals relating the

factors contributing to unplanned extubation, enhanced teamwork amongst healthcare providers and improved ownership of the collaborative developed learning events. This in turn decreased the complications associated with unplanned extubation and had a positive outcome on terms of quality care provided to mechanically ventilated paediatric patients.

Key Words: Learning events, unplanned extubation, paediatric intensive care unit, paediatric patient.

TABLE OF CONTENT		
CHAPTER 1: ORIENTATION TO THE STUDY		
1.1	INTRODUCTION AND BACKGROUND	1
1.2	PROBLEM STATEMENT	2
1.3	RESEARCH QUESTION	3
1.4	AIM AND OBJECTIVES	3
1.5	SETTING	3
1.6	SIGNIFICANCE OF THE STUDY	4
1.7	CLARYFICATION OF KEY CONCEPTS	4
1.7.1	Learning event	5
1.7.2	Unplanned extubation	5
1.7.3	Peadiatric critical care unit	5
1.7.4	Peadiatric patient	6
1.8	ETHICAL CONSIDERATIONS	6
1.8.1	Scientific honesty	6
1.8.2	Informed consent	7
1.8.3	Principle of beneficence	7
1.8.4	Principle of respect for human dignity	7
1.8.5	Principle of the right to justice	8
1.9	LAYOUT OF CHAPTERS	8
1.10	SUMMARY	8
CHAPTER 2: LITERATURE REVIEW		
2.1	INTRODUCTION	9
2.2	CRITICAL ILL PEADIATRIC PATIENT	9
2.2.1	Age group	10
2.2.2	Indications	10
2.2.3	Complications	11
2.3	ANATOMICAL STRUCTURES	11
2.3.1	Anatomical considerations	12
2.4	AIRWAY MANGEMENT	14
2.4.1	Tracheal intubation	14
2.4.1.1	<i>Cuff versus uncuffed tracheal tubes</i>	16

2.4.2	Tracheostomy	16
2.5	UNPLANNED EXTUBATION	17
2.5.1	Strategies to prevent unplanned extubation	19
2.5.1.1	<i>Physical restraints</i>	19
2.5.2	Chemical restraints	21
2.5.2.1	<i>Morphine</i>	22
2.5.2.2	<i>Midazolam</i>	22
2.5.2.3	<i>Neuromuscular blockers</i>	23
2.5.3	Monitoring effectiveness of chemical restraints	23
2.5.4	Ethical and legal considerations	24
2.6	CONCLUSION	25

CHAPTER 3: RESEARCH DESIGN AND METHODS

3.1	INTRODUCTION	26
3.2	RESEARCH AND OBJECTIVES	26
3.3	RESEARCH DESIGN	26
3.3.1	Phase 1 and 3: Pre- and post-test	27
3.3.1.1	<i>Quantitative design</i>	27
3.3.1.2	<i>Retrospective design</i>	27
3.3.1.3	<i>Descriptive design</i>	28
3.3.2	Phase 2: Implementation	28
3.4	RESEACRH METHODS	29
3.4.1	Phase 1	29
3.4.1.1	<i>Unit of analysis</i>	29
3.4.1.2	<i>Sampling process</i>	30
3.4.1.3	<i>Data collection process</i>	30
3.4.1.4	<i>Data analysis</i>	32
3.4.1.5	<i>Validity and reliability</i>	32
3.4.2	Phase 2	33
3.4.2.1	<i>Population</i>	34
3.4.2.2	<i>Sampling</i>	34
3.4.2.3	<i>Data collection</i>	34
3.4.2.4	<i>Data analysis</i>	38

3.4.2.5	<i>Trustworthiness</i>	40
3.4.3	Phase 3	41
3.5	SUMMARY	42

CHAPTER 4: STUDY FINDINGS

4.1	INTRODUCTION	43
4.2	OVERVIEW OF FINDINGS	43
4.3	PHASE 1: PRE-TEST	43
4.3.1	Section A: Demographic information	44
4.3.2	Section B: Incidents	44
4.3.3	Section C: Chemical restraints	44
4.3.4	Section D: Physical restraints	44
4.3.5	Section E: Complications	45
4.4	PHASE 2: DEVELOPMENT AND IMPLIMENTATION OF LEARNING EVENTS	45
4.4.1	Contributing factor 1: Inappropriate physical restraints	47
4.4.1.1	<i>Strategy 1: Informed consent</i>	49
4.4.1.2	<i>Strategy 2: Application method</i>	50
4.4.1.3	<i>Strategy 3: Rest period</i>	53
4.4.1.4	<i>Strategy 4: Documentation</i>	54
4.4.2	Contributing factor 2: Ineffective sedation	55
4.4.2.1	<i>Strategy 1: Medication</i>	55
4.4.2.2	<i>Strategy 2: Level of sedation</i>	56
4.4.2.3	<i>Strategy 3: Weaning from sedation</i>	57
4.4.3	Work group 1: Appropriate physical restraints	59
4.4.4	Work group 2: Effective sedation	60
4.5	PHASE 3: POST-TEST	62
4.5.1	Section A: Demographic information	62
4.5.2	Section B: Incidents	63
4.5.3	Section C; Chemical restraints	63
4.5.4	Section D: Physical restraints	63
4.5.5	Section E: Complication	64
4.6	SUMMARY	64

CHAPTER 5: CONCLUSION, RECOMMENDATION AND LIMITATIONS		
5.1	INTRODUCTION	65
5.2	AIM AND OBJECTIVES	65
5.3	CONCLUSIONS	65
5.3.1	Objective 1: Pre-test	66
5.3.2	Objective 2: Development and implementation of learning events	66
5.3.3	Phase 3: Post-test	67
5.4	RECOMMENDATIONS	68
5.5	LIMITATIONS	69
5.6	FUTURE RESEARCH	70
5.7	CONCLUSION	70
	REFERENCE LIST	71

LIST OF TABLES		
Table 2.1	Size and length of tracheal tubes for paediatric patients	15
Table 3.1	Application of the characteristics of a qualitative research design	28
Table 4.1	Summary of additional qualifications of professional nurses	46
Table 4.2	Summary of the contributing factors and planned strategies	47
Table 4.3	Appropriate physical restraints: Summary of strategies implemented	60
Table 4.4	Effective sedation: Summary of strategies implemented	62

LIST OF FIGURES		
Figure 2.1	Anatomical differences particular to infants, children and adults	12
Figure 2.2	Examples of the different types of tracheal tubes	15

LIST OF ANNEXURES		
Annexure A	Ethical approval to conduct the research	
A.1	University of Pretoria: Faculty of Health Sciences Research Committee	
A.2	Academic Hospital	
Annexure B	Clinical audit tool	
Annexure C1	Invitation to focus group interview	
Annexure C2	Participant information leaflet and informed consent (Focus group)	
Annexure C3	Power point presentation	
Annexure C4	Field notes from focus group interview	
Annexure D	Participant information leaflet and informed consent (Work group)	
Annexure E1	Posters in restraining method	
Annexure E2	Informed consent to restrain	
Annexure E3	Sedation protocol	
Annexure F	Declaration from the editor	

LIST OF ABBREVIATIONS

FGI	Focus group interview
PICU	Peadiatric intensive care unit
VAP	Ventilated associated pneumonia

1 ORIENTATION TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND

Unplanned extubation of the paediatric patient is a disturbing global phenomenon; unplanned extubation accounts for 3% to 14% per 100 ventilation days of extubation in paediatric intensive care units (PICUs) in hospitals worldwide (Rachman & Mink 2012:614; Birkett, Southerland & Leslie 2005:66; Yeh et al. 2004:255). In the PICU where the researcher works as a paediatric critical care nurse, the average unplanned extubation rate is an alarming 20% per 100 ventilation days – thus, a disturbing 6% to 17% higher than the global manifestation. Da Silva and de Carvalho (2010:287) unequivocally state the unplanned extubation of a paediatric patient is an adverse, avoidable event and therefore studies are needed to establish recommendations to prevent unplanned extubation.

Den Hollander and Muckhart (2009:22) and Curry et al. (2008:46) explain that unplanned extubation is the premature removal of the endotracheal tube by actions of the patient (self-extubation or treatment interference) or the premature removal by medical personnel during care and/or manipulation of the patient, for example, by moving the patient (accidental extubation). Paediatric patients are at particular high risk for unplanned extubation due to their short tracheal length, the use of uncuffed oral endotracheal tubes, and the patients' developmental immaturity which may limit cooperation with healthcare personnel (Ream et al. 2007:366). Unplanned extubation can lead to complications that may result in significant increases in the morbidity and mortality of paediatric patients (Popat et al. 2012:319). Complications such as stridor, hypoxia and respiratory failure can occur (da Silva, Reis, Aguiar & Fonseca 2012:1243; da Silva & de Carvalho 2010:288). Unplanned extubation is also associated with further complications including upper airway trauma, hypotension or hypertension, new arrhythmia, bradycardia and cardiac arrest (Proehl 2009:51; Rachman, Watson, Woods, Mink 2009:1; Curry et al. 2008:46).

According to da Silva and de Carvalho (2010:287), unplanned extubation often leads to emergent, less controlled endotracheal reintubation. Additional costs are incurred for the time required from a paediatrician and/or anaesthetist to reintubate the patient, the nurses' time, other multidisciplinary staff members' time, equipment, other medications and laboratory tests (Curry et al. 2008:47). Further costs include prolonging the length of stay in the hospital (Rachman & Mink 2012:619; Curry et al. 2008:46; Proehl 2009:51).

Unplanned extubation is a challenge that needs to be addressed urgently. The researcher's intent with this study was to identify factors associated with the incidence of unplanned extubation and to collaboratively plan and implement learning events in the PICU based on the identified factors to decrease the incidence of unplanned extubation of paediatric patients.

1.2 PROBLEM STATEMENT

The incidence of unplanned extubation and the associated factors in the PICUs in South Africa is limited (Mpe, Moloto & Mphahlele 2004:17). The factors were inadequate sedation, physical restraints and securing of the tracheal tube. The PICU where the researcher works is facing an enormous challenge because over the past three years (from 2013) the incidence of unplanned extubation has been an extreme 20% of all mechanically ventilated paediatric patients per 100 ventilation days (The Hospital Statistics July – November 2013).

Unplanned extubation in paediatric patients can lead to life-threatening complications (Rachman & Mink 2012:619; da Silva & de Carvalho 2010:287) which in turn increases the hospital stay and, consequently, hospital stay costs. A zero unplanned extubation rate would be the ideal, but an initial decrease to at least the international incidence rate (3% to 14% per 100 ventilation days) can be seen as taking a decisive step towards decreasing avoidable complications, relieving unnecessary stress and trauma for the paediatric patient as well as their families, and decreasing hospital costs as suggested by Rachman et al. (2012:619) and Rachman et al. (2009:1).

These authors suggest that factors contributing to unplanned extubation should be identified and addressed in the clinical setting.

1.3 RESEARCH QUESTION

The research question that was derived from the problem statement is:

What effect will the implementation of a co-constructed learning event have on the incidence of unplanned extubation in the PICU?

1.4 AIM AND OBJECTIVES

The overall aim of this study was to plan and implement a learning event to decrease the incidence of unplanned extubation in the PICU.

The objectives were to:

- assess the incidence of unplanned extubation in a selected PICU (pre-test);
- develop and implement a co-constructed learning event in the selected PICU; and to
- re-assess the incidence of unplanned extubation in the selected PICU following the implementation of the learning event (post-test).

1.5 SETTING

The study setting refers to the location in which a study is conducted (Burns & Grove 2013:709) and Polit and Beck (2012:743) refer to the setting as “the physical location and conditions in which data collection takes place in a study”. The setting for this study was an academic hospital in Gauteng. At the time the study was conducted, the hospital had 832 beds; this number included a combined total of 92 beds in the critical care and high care units. The critical and high care beds were allocated as follows: 40 adult critical care beds, 25 high care beds, 7 in the paediatric intensive care unit (PICU) as well as 20 neonatal critical care beds (The Hospital Statistics, July – November 2013).

At the time of study the average bed occupancy of the seven PICU beds was 88% and 16 healthcare professionals rendered care to the paediatric patients (The Hospital Statistics, July – November 2013). The permanent staff at the time included one rotating paediatrician, one medical consultant, and two paediatric specialist professors.

This specific PICU generally serves patients who are in need of specialised care in Gauteng as well as from other neighbouring provinces, for example, North West, Mpumalanga and Limpopo. Various specialists such as paediatricians, pulmonologists, cardiologists, neurosurgeons, radiologists and intensivists are available 24 hours a day on a consultation basis.

1.6 SIGNIFICANCE OF THE STUDY

The significance of this study will be, firstly, to enable the researcher and healthcare practitioners to collaboratively identify the factors associated with unplanned extubation in the specific PICU. Based on these identified factors, the researcher in collaboration with the unit manager and other healthcare practitioners involved in the management of the mechanically ventilated paediatric patient will develop learning events in an attempt to decrease the incidence of unplanned extubation. Such learning events can help the healthcare professionals to enhance their knowledge pertaining to factors associated with the incidence of unplanned extubation. If unplanned extubation can be decreased, it should in turn minimise the complications associated with unplanned extubation as well as decrease the length of stay and the overall financial implications of hospitalisation for both the families and the South African Government.

1.7 CLARIFICATION OF KEY CONCEPTS

The key concepts are clarified in order to prevent misunderstanding and to clearly state the meaning of each concept.

1.7.1 Learning event

A learning event is “the joined description of the paradigms of a learner’s activity and a researcher activity; it can be complementary and interdependent in a learning situation” Leclercq & Poumay (2005:1).

In this study a ‘learning event’ refers to the activities collaboratively planned by the healthcare practitioners that will be implemented to address the incidence of unplanned extubation in the PICU.

1.7.2 Unplanned extubation

‘Unplanned extubation’ is defined as the unintentional removal of an endotracheal tube by healthcare practitioners or the paediatric patient (Curry et al. 2008:45). Unplanned extubation can be accidental, unintentional or self-extubation by the patient as mentioned by da Silva and de Carvalho (2010:287).

For the purpose of this study ‘unplanned extubation’ refers to the unintentional removal of the endotracheal tube by either the staff or the patient before the planned removal time.

1.7.3 Paediatric critical care unit (PICU)

Stanton and Behrman (2007:1) state ‘paediatrics’ is concerned with the health of infants, children, and adolescents, their growth and development. The paediatric critical care unit (PICU) is a specialised environment (Potts and Mandleco, 2007:481). It is important to note that the paediatric patient differs anatomically, physiologically and emotionally from the adult patient (Schmitt and Gausche-Hill, 2011:9).

In the study the key concept ‘paediatric critical care unit’ (PICU) pertains to the dedicated critical care unit in the specific academic hospital in Gauteng specialising in the management, care and mechanical ventilation of critical ill paediatric patients with medical and/or surgical conditions.

1.7.4 Paediatric patient

The 'paediatric patient' is defined by the Emergency Medical Services Authority (EMSA) (2011:1) as "a patient equal or less than fourteen (14) years of age".

For the purpose of this study, the key concept 'paediatric patient' refers to a mechanically ventilated patient between 28 days and 12 years old.

1.8 ETHICAL CONSIDERATIONS

Ethics is defined as a system of moral values that is concerned with the degree to which research procedures adhere to professional, legal and social obligations to study participants (Polit & Beck 2012:727). Ethical approval was obtained from the Faculty of Health Sciences: Research Ethics Committee of the University of Pretoria (view Annexure A.1) as well as from the academic hospital (view Annexure A.2).

The Belmont Report identifies three main ethical principles on which the standards of ethical conduction in research are based: i) beneficence, ii) respect to human dignity, and iii) justice (Polit & Beck 2012:152). An additional principle of scientific honesty was added as suggested by Brink, van der Walt and van Rensburg (2006:40).

1.8.1 Scientific honesty

According to Brink et al. (2006:40), scientific knowledge has to be utilised in such a way that its integrity is not infringed and the rights of the community is protected. Brink et al. (2006:40) identify activities that should be avoided in order to uphold honesty during research. These activities include: falsification (for example, reflecting a non-existent report or manipulation of a design to match the researcher's own pre-set assumptions); manipulation of data (in other words the researcher chooses only data that will prove her or his own point of view); and plagiarism (where the researcher makes use of someone else's work without proper acknowledgement thereof). The current researcher complied with these requirements by maintaining honesty throughout the study. To substantiate the researcher's dedication to honesty and objectivity in this study, a declaration form to this effect was signed by the researcher (view Page i).

1.8.2 Informed consent

Informed consent is an ethical principle that implies it is the researcher's moral duty to disclose specific data regarding the proposed study to every prospective participant before the study is conducted (Polit & Beck 2012:730). In the current study a retrospective audit of the files of paediatric patients where incidences of unplanned extubation occurred was done (Phases 1 and 3). The informed consent to gain access to the patients' files was provided by the superintendent of the specific academic hospital (view Annexure A.2). The name of neither the academic hospital nor its street address is mentioned; it is only referred to as 'the hospital' to guarantee confidentiality and anonymity. Participants who voluntarily participated in Phase 2 were not named, and each participant voluntarily signed an informed consent document (view Annexure C2).

1.8.3 Principle of beneficence

The principle of beneficence focuses on the importance of securing the well-being of participants who has the right to be protected from discomfort and harm (Polit & Beck 2012:152). Burns and Grove (2013:687) maintain that the ethical principle of beneficence "holds that one should do well and, above all, do no harm". In Phases 1 and 3 the files of mechanically ventilated paediatric patients were audited and no discomfort or harm to these patients was foreseen, as only the flow charts of the patients were audited. During Phase 2 there was collaboration between the researcher and healthcare professionals to co-construct a learning event to address the incidence of unplanned extubation in the PICU. Thus, during Phase 2 there was also no anticipated discomfort or harm to the participants. The participants were reassured that the data collected from Phases 1 and 3 would not be used against them.

1.8.4 Principle of respect for human dignity

Polit and Beck (2012:154) state the principle of respect for human dignity includes the right to self-determination and the right to full disclosure. The healthcare practitioners were formally invited to attend the focus group (Phase 2). Volunteer participants were given an information leaflet and informed consent was obtained following the explanation of the purpose, significance of the study as well as the expected benefit to the PICU and the particular hospital. Enough time was allowed

for the participants to ask questions to clarify any uncertainties before they were requested to sign the informed consent document (view Annexure D).

1.8.5 Principle of the right to justice

Polit and Beck (2012:155) describe justice as the right to fair treatment and the right to privacy. The academic hospital involved was not named; patients were not identified and cannot be traced as their hospital numbers were not documented. The files were graded in numerical order – in no particular sequence – starting from 1 to 30 as suggested by the statistician. All the gathered data were kept strictly confidential. The time, date and venue for the focus group (Phase 2) were negotiated during the planning session to ensure the data gathering process would not interfere with patient care. In addition, this pre-planning provided an opportunity for healthcare practitioners who were interested in participation to pre-plan their work schedule to make sure they would have the time available to take part in the focus group discussion.

1.9 LAYOUT OF CHAPTERS

The chapter layout for this study is as follows:

- **Chapter 1:** Orientation to the study
- **Chapter 2:** Literature review
- **Chapter 3:** Research design and methods
- **Chapter 4:** Results and discussion
- **Chapter 5:** Conclusion, recommendations and limitations

1.10 SUMMARY

In this chapter the background to the problem, the problem statement, research question, and aim and objectives were provided. The setting in which the study was conducted was described and the significance of the study explained. An outline of the ethical considerations was provided followed by an outline of the chapters. In Chapter 2 an in-depth discussion of literature pertaining to the research topic will be provided.

2 LITERATURE REVIEW

2.1 INTRODUCTION

In Chapter 1 an orientation to the study was presented. Background was given on what is known about unplanned extubation in the paediatric intensive care unit (PICU). In this Chapter an in-depth discussion on current literature pertaining to the unplanned extubation of the paediatric patient is provided. Topics focusing on the critically ill paediatric patient are covered. These include an explanation of the critically ill paediatric patient in terms of age groups, indication and complications; a discussion relating to the anatomical and physiological differences between the adult and paediatric patient, airway management, unplanned extubation, nursing considerations pertaining to mechanical ventilation of the paediatric patient, paediatric reintubation related complications, and preventative strategies concerning quality assurance that can be addressed.

2.2 CRITICALLY ILL PAEDIATRIC PATIENT

A critically ill patient is an adult, child or infant with an acute, life-threatening illness or injury who is mechanically ventilated and thus needs advanced airway management for conditions such as pneumonia and raised intracranial pressure (Stevenson & Waite 2011:339; Urden, Stacy & Lough 2002:143-500). Also the critically ill patient is at risk for actual or potential life-threatening health problems; his or her medical condition is more unstable and complex. These patients therefore require intense and vigilant nursing care; this type of thorough and inclusive nursing care is provided in an intensive care unit as suggested by (Potts and Mandelco, 2007:481).

Critically ill paediatric patients are managed in a PICU. In Sections 2.2.1 to 2.2.4 of this chapter the paediatric critically ill patient will be discussed in terms of the specific

age groups that are admitted to the PICU, the indication and complications of mechanical ventilation, and the incidence of unplanned intubation.

2.2.1 Age group

In the Child Act No. 38 of 2005, Section 1 (1) (g) of t, a child is defined as a person younger than 18 years old (Republic of South Africa 2005a). Explaining the different representative age groups of paediatric patients, James et al. (2013:44) confirms Wittenberg's (2009:21) assertion that four distinct age groups characterise a child's life cycle (from birth to school-leaving age).

- **Neonate and infant:** the neonatal period is sub-divided into the *early neonatal period* (which stretches from birth to seven days) and the *late neonatal period* (which is from the eighth day after birth to the 28th day of life). Infancy is indicated as the first year of life period.
- **Toddler:** the toddler is a "child developing through the first and second year of life" (James et al. 2013:44; Wittenberg 2009:21).
- **Pre-schooler:** is a child between the ages of two and five years old.
- **School-aged child:** a child from six years old until the age she or he leaves school.

Current practices are that the early and late period critically ill neonate is admitted to a neonatal intensive care unit. The infant, toddler, pre-schooler and school-aged child up to 12 years are admitted to the PICU. Critically ill paediatric patients 13 years and older are admitted to an adult ICU.

2.2.2 Indications

The critically ill patient often requires mechanical ventilation. To facilitate advanced airway management and effective ventilation, a tracheal tube is inserted. The tracheal tube is attached to a mechanical ventilator and used in the treatment of, for example, airway obstruction, respiratory failure and neurological diseases (da Silva & Carvalho 2010:189). The core rationale for inserting a tracheal tube is the presence or failure of ventilation and/or adequate oxygenation. The tracheal tube may protect the trachea and lung from aspiration due to, for example, gastric contents, saliva or fluid in the upper airway. The tracheal tube further allows direct

access to the lung for suctioning of secretions and can also be used for the administration of emergency medication (Proehl 2009:28).

2.2.3 Complications

Complications associated with tracheal intubation in the paediatric patient include oesophageal intubation, potential damage to the teeth, nasal mucosa, posterior pharynx and/or larynx, and dislodgement of the tube (Proehl 2009:33). However, unplanned tracheal extubation is recognised as the most common airway adverse event in the PICU (Proehl 2009:33; Rachman & Mink 2012:1).

Unplanned extubation is a potentially life-threatening incident that leads to haemodynamic instability, airway complications such as an increased risk of laryngeal or tracheal injury and scarring, pulmonary injury from excessive ventilation, ventilator-associated pneumonia (VAP), and death (Proehl 2009:33; Morrow, Argent, Jeena & Green 2009:1; Curry et al. 2008:46; Yeh et al. 2004:256). Unplanned extubation in the paediatric patient leads to a significantly longer duration of mechanical ventilation, longer stay in the PICU, increased resource utilisation, and longer hospital stay (da Silva et al. 2010:287).

The paediatric patients are at risk for unplanned extubation due to their anatomical structures that differ from those of adult patients.

2.3 ANATOMICAL STRUCTURES

The respiratory system plays a vital role in ventilation and oxygenation. The respiratory system is composed of the upper and lower respiratory tracts. The upper respiratory tract consists of the nose, pharynx, larynx, and the trachea. The lower respiratory tract of the lung comprises alveoli (Eber & Midulla 2013:1; Smeltzer, Bare, Hinkle, & Cheever 2010:487). The upper respiratory tract warms and filters inspired air in order for the lower respiratory tract to achieve gaseous exchange (Peate & Nair 2011:334; Smeltzer et al. 2010:487).

For healthcare professionals working with critically ill paediatric patients, it is vital to have knowledge and recognise the anatomical considerations of the paediatric patient when intubating and managing them (Millers, Eriksson, Wiener-Kronish & Young 2010:2662).

2.3.1 Anatomic considerations

The paediatric patient has specific anatomical structures that should be considered during intubation. In Figure 2.1 the anatomical differences particular to infant, children and adult patients as adopted from Walls and Murphy (2008:270) are shown.

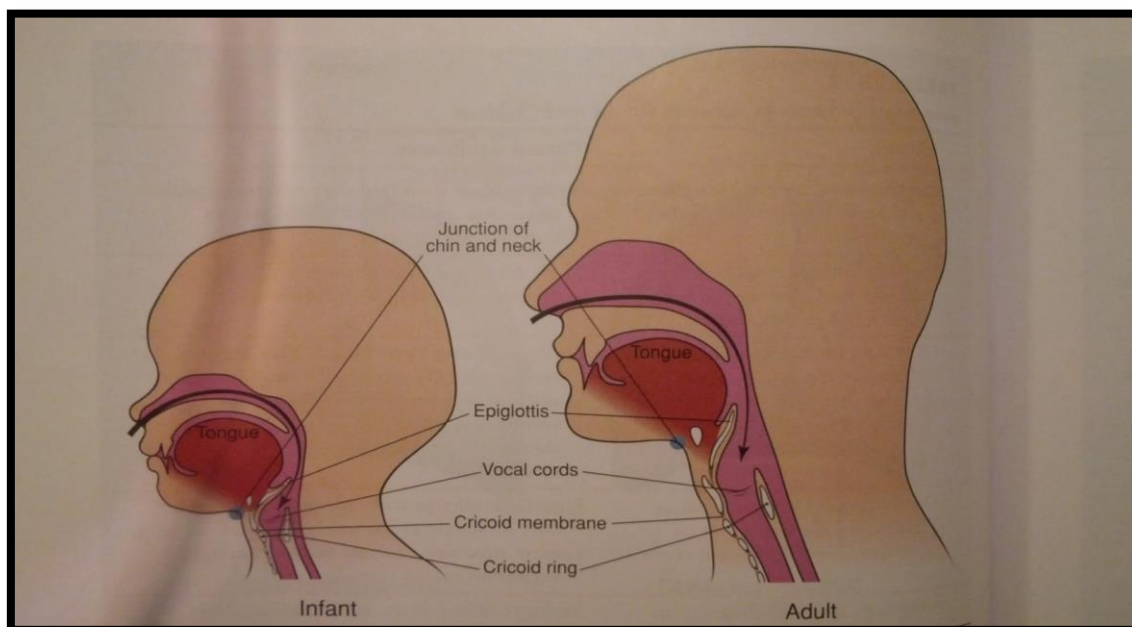


Figure 2.1: Anatomical differences particular to infants, children and adults (Walls & Murphy 2008:270)

Infants and young children have a relatively large occiput and short neck; therefore, they have a more anterior and cephalic larynx (Stewart 2006:3; Santillanes & Gausche-Hill 2008:962). Walls and Murphy (2008:269) state when lying supine, the shortness of the neck can result in neck flexion and potential airway obstruction. As young children have a shorter and softer trachea, overextension of the neck could kink the trachea and the tracheal tube can more easily become displaced (Jevon 2012:67). Consequently, any hyperextension of the neck in paediatric patients may

worsen obstruction of the upper airway (Bailey, Torrey & Wiley 2013:1; Jevon 2012:67; Miller et al. 2010:2562). Placing a towel roll under the shoulders can improve airway alignment in children (Nagler, Stack & Wiley 2013:1).

Healthcare professionals must bear in mind that infants under six months old are nasal breathers and therefore their narrow nasal passages can easily be obstructed by mucous secretions which may lead to the airway becoming compromised (Jevon 2012:67; Santillanes & Gausche-Hill 2008:962). The epiglottis of infants and young children is large and floppy and is at the level of C3 – C4 thus making tracheal intubation more difficult. The adult epiglottis is firm and flatter at the level of C5 – C6 (Jevon 2012:67; Marcdante, Kliegman, Jenson & Behrman 2011:147).

Within the oral cavity, the tongue of an infant and paediatric is proportionally larger than in older children and adults which causes airway obstruction (Jevon 2012:67; Santillanes & Gausche-Hill 2008:962; Walls & Murphy 2008:269). Therefore, a straight blade during tracheal intubation is preferred over the curved one to push the distensible anatomy out of the way so that the larynx can be visualised during intubation of infants and young children (Walls & Murphy 2008:269; Stewart 2006:3).

The paediatric patient's larynx is shaped like a funnel and is positioned higher and more anteriorly whereas the adult larynx is cylindrical or column straight up and down at the level of the vocal cords. Children generally have larger tonsils and adenoids than adults. Large tonsils and adenoids may bleed and the more acute angle between the epiglottis and laryngeal opening can lead to aspiration; this angle also makes glottis visualisation challenging (Nagler et al. 2013:1; Walls & Murphy 2008:269).

In adults the narrowest diameter of the airway is at the vocal cords and in children it is at the cricoid cartilage ring. As a result of the subglottic narrowing in children, foreign bodies can become lodged below the cords. Stewart (2006:3) states the diameter of the paediatric airway is much smaller than the adult airway thus making it far more vulnerable to obstruction by either oedema or foreign objects. Although the tracheal tube may be small enough to pass through the cords, it may be not

small enough to go beyond the cricoid ring (Nagler et al. 2013:2; Santillanes & Gausche-Hill 2008:962; Walls & Murphy 2008:269).

The chest wall of children is significantly more compliant than that of an adult. Therefore, infants and children are more likely to experience respiratory muscle fatigue, atelectasis and respiratory failure (Jevon 2012:68; Nagler et al. 2013:2; Stewart 2006:4). Infants have more horizontal ribs and a flatter diaphragm than adults. A child's ribcage is softer and more compliant (much more than that of an adult) and it thus contributes less to chest expansion during breathing (Jevon 2012:68; Kliegman, Stanton, St Geme, Schor & Behrman 2011:1419; Santillanes & Gausche-Hill 2008:962; Stewart 2006:4). Infants have lower stores of glycogen and fat in their respiratory muscles and they can therefore easily become hypoxic (McMillan, Feigin, De Angelis & Jones 2006:302).

Many paediatric patients need airway management which may include tracheal or endotracheal intubation and cuffed versus uncuffed pressure challenges (view Section 2.4.1.1). Nasopharyngeal airways are more difficult to pass in infants less than one year old due to the largeness of the adenoidal tissues which may make nasotracheal intubation more difficult. In the view of Stewart (2006:3), this is the reason why nasotracheal intubation is generally not recommended in this age group. The narrow tracheal lumen, combined with the narrow space between the tracheal rings and the small size of the cricothyroid membranes, make needle or surgical cricothyroidotomy technically challenging in infants and children (Nagler et al. 2013:2).

2.4 AIRWAY MANAGEMENT

In the paediatric patient the airway is managed by means of tracheal intubation using a cuffed or uncuffed tracheal tube or by undergoing a tracheostomy.

2.4.1 Tracheal intubation

Tracheal intubation is the passing of a tube directly into the trachea (Proehl 2009:27; Smeltzer et al. 2010:635). Tracheal intubation is the most secure and effective way to establish and maintain the airway. It enables optimal control of the airway

pressure and provides positive end expiratory pressure (Biarent et al. 2010:1372). Different types of tracheal tubes are used in practice today as shown in Figure 2.2.

In the PICU, orotracheal intubation is preferred because fewer complications can occur than with nasotracheal intubation. The importance of choosing the correct size and length for neonates, infants and paediatric patients is emphasised. The larynx and airways can be damaged if an improper size endotracheal tube is inserted; it can also cause an air leak and mucosal damage (Marcdante et al. 2011:505). It can increase risk of kinking and post extubation stridor (Weiss, Dullenkop, Fischer, Keller, Gerber 2009:870).

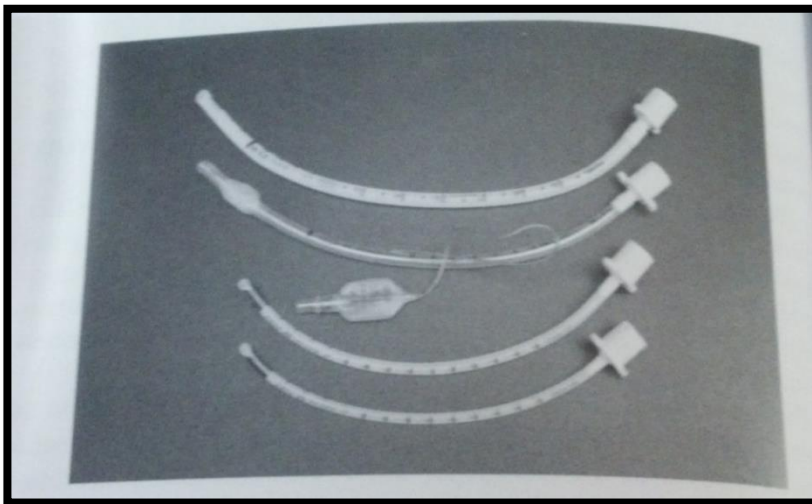


Figure 2.2: Examples of the different types of tracheal tubes used today (Jevon 2012:80)

In Table 2.1 a summary of the correct size and length of tracheal tubes for the intubation of neonates, infant and paediatric patients are shown as adapted from Proehl (2009:32), Urden et al. (2002:147) and Kliegman et al. (2011:320).

Table 2.1: Size and length of tracheal tubes for paediatric patients

	Weight (kg)	Tracheal tube size (mm: internal diameter)
Premature	1.5 – 2	3
Newborn – 3 months	3 – 6	3.5
6 – 12 months	7 – 10	4
2 years	12	5

Age	Weight (kg)	Tracheal tube size (mm: internal diameter)
4 years	16	5.5
6 years	20	6
8 years	25	6.5
10 years	34	6.5
12 years	40	6.5 – 6.7
14 years	50	7

2.4.1.1 Cuffed versus uncuffed tracheal tubes

Cuffed tracheal tubes are considered standard care in adults requiring airway management. Traditionally, the use of cuffed tracheal tubes in children less than 10 years old has been discouraged because it can cause tissue damage resulting in subglottic stenosis (Dorsey et al. 2009:856). Cuffed endotracheal tubes prevent the unintended loss of tidal volume (air leaks) around the endotracheal tube (Weiss et al. 2009:867).

The children in the PICU who are younger than eight are generally intubated with uncuffed tracheal tubes because it seals well at the cricoid ring of the infant (Newth, Rachman, Patel & Hammer 2004:335). However, in the paediatric patient with poor lung compliance or high airway resistance, a cuffed tube may be necessary to provide adequate ventilation and prevent unplanned extubation (Proehl 2009:32). Children receiving uncuffed tubes are associated with less subglottic stenosis, but there is a loss of tidal volume (Dorsey et al. 2009:856). Using uncuffed tracheal tubes for the intubation of neonates, infants and young children also lessens complications such as stridor, pneumonia and unplanned extubation (Dorsey et al. 2009:857). Most paediatric patients cough out the tube due to irritability and too little sedation. These seem to be major reasons for the high incidences of unplanned extubation in the PICU (The Hospital Statistics 2013).

The following formulae are recommended by Nishisaki et al. (2011:387) for tracheal tube sizes:

- cuffed tracheal tube size: Age (years)/4+3 mm internal diameter
- uncuffed tracheal tube size: Age (years)/4+4 mm internal diameter.

2.4.2 Tracheostomy

A tracheostomy is also known as a 'trach', surgical airway or an open tracheostomy (Aehlert, 2012:416; Proehl 2009:70). A tracheostomy is a surgical method used as a last resort after multiple non-invasive attempts have failed or repeated unplanned extubation have occurred. A tracheostomy is performed when the lower airway is obstructed because of a disease process such as asthma or excessive secretions (James et al. 2013:211). According to Tasker, McClure and Acerini (2013:210), it bypasses upper airway obstruction and is performed when oral or oronasal endotracheal intubation fails or is contraindicated. The smaller diameter tracheostomy tubes used in infants and children require diligent pulmonary hygiene and the delivery of humidified gas to prevent the formation of mucus plugs (Proehl 2009:74). Because the paediatric patient has a small, pliable, mobile larynx and cricoid cartilage, it makes cricothyrotomy extremely difficult (Walls & Murphy 2008:195).

2.5 UNPLANNED EXTUBATION

Unplanned extubation is an unscheduled event in which an airway is observed dislodged from the trachea or a sudden loss of bilateral breathing sounds occurs that cannot be re-established by suctioning or advancement of the airway (da Silva et al. 2012:1238; Sadowski et al. 2004:628). Popernack et al. (2004:58) describe unplanned extubation as referring to an incident where displacement of the end tracheal tube occurs at any times other than the time chosen for planned extubation.

Infants and young children are at particular risk for unplanned extubation due to their short tracheal length as well as the uncuffed, oral tracheal tube frequently used in this population (Ream et al. 2007:366). Additional factors such as the use of uncuffed tubes in combination with a lack of cognitive and emotional maturity to accept and tolerate an artificial airway are also likely to contribute to a higher rate of unplanned extubation in younger patients (Sadowski et al. 2004:631). Increased tracheal tube movement by weak fixation can increase the child's level of discomfort and the risk of unplanned extubation (Birkett et al. 2005:72). The frequency of unplanned extubation in the PICU may also be ascribed to the infant or young child's

inability to actively communicate with the healthcare providers in the PICU. Moreover, repeated intubations – especially those performed in emergency cases such as continuous intubations as a result of unplanned extubation – do increase the risk of pulmonary injuries and also ventilator-associated pneumonia (VAP) (da Silva et al. 2012:1239).

- complete airway obstruction;
- laryngospasm, bronchospasm and pulmonary aspiration;
- hypoxia secondary to aspiration or improper placement of the tube;
- epistaxis and sinusitis;
- trauma due to mucosa of airways and broken teeth; and
- stridor, nasal flaring and sternal recession.

The paediatric patient in the PICU can experience potentially serious respiratory complications: stridor, hypoxia, dyspnoea, sternal recession, hyperventilation, poor blood gas (especially diffused oxygenation problems) and respiratory acidosis. This is the result of an extended period of time and long ventilator use and is costly for the hospital (Chen et al. 2010:124; Birkett et al. 2005:66).

Reintubation of paediatric patients can be difficult in the PICU and can lengthen hospitalisation. Additional complications related to unplanned extubation include oedema of the larynx, laryngospasm, bronchospasm, aspiration pneumonia, tracheal injury and respiratory failure. Further complications after unplanned extubation mentioned in literature are pneumothorax, pneumomediastinum and atelectasis (da Silva, de Aguiar, Neto & de Carvalho 2008:1211; Birkett et al. 2005:66; Yeh et al. 2004:255).

The ineffective airway clearance can cause a mucous plug and sepsis. In addition, it was found ventilator associated pneumonia (VAP) occurred frequently on repeated intubation (Chen et al. 2010:124; da Silva & de Carvalho 2010:287). Unplanned extubation in the PICU can result in serious complications such as hypertension, hypotension, tachyarrhythmia, bradycardia and even death (Chen et al. 2010:120; Curry et al. 2008:46; Birkett et al. 2005:66; Kurachek et al. 2003:2658). The repeated reintubation of paediatric patients may be associated with temporary adverse

physiologic changes including hypercarbia, hypoxaemia, increased arterial pressure, and increased intracranial pressure. Also, cardiopulmonary arrest, asphyxia with temporary or permanent brain injury, and death can be the result of unplanned extubation that leads to repeated reintubation (Chen et al. 2010:124; da Silva & de Carvalho 2010:287; da Silva et al. 2008:1211).

As paediatric patients require reintubation following unplanned extubation, additional complications may occur. These complications are related to haemodynamic instability. Paediatric patients can consequently develop hypertension, tachycardia, bradycardia, hypotension and dysrhythmias (Miller et al. 2010:1601). Death may occur if sedatives and neuromuscular blocking agents are given to reintubate the patient and these attempts are unsuccessful.

Unplanned extubation is associated with longer length of mechanical ventilation and length of stay in the PICU (Sadowski et al. 2004:628). Even after successful reintubation, problems such as laryngeal injury, malposition, pulmonary injury from excessive ventilation and tracheal injury may occur thus further increasing the morbidity and mortality of the critically ill paediatric patient (da Silva et al. 2012:1239; da Silva & de Carvalho 2010:287).

2.5.1 Strategies to prevent unplanned extubation

Preventing unplanned extubation is vital and remains the responsibility of the healthcare providers. Preventative strategies include physical and chemical restraints.

2.5.1.1 Physical restraints

Physical restraints are manual, physical or mechanical devices, material, or equipment attached or adjacent to the paediatric patient's body in such a way that it cannot easily be removed; it therefore restricts freedom of movement to prevent unplanned extubation (Chang, Wang & Chao 2008:409; Hofso & Coyer 2007:25; Ofoegbu & Playfor 2006:1129; Martin et al. 2002:299). Physical restraints are widely used in PICUs in an attempt to reduce the risk of treatment interference as well as to prevent unplanned extubation and subsequent complications (Chang et al. 2008:409).

Risk factors related to mechanically ventilated paediatric patients include restlessness, agitation, confusion, physical suffering and nosocomial infection (Chang et al. 2008:409). Physical restraints prevent falling off the bed and unplanned extubation (Martin & Mathisen 2005:134). Using physical restraints keeps paediatric patients safe and prevents them from removing invasive tubes thereby interfering with the prescribed treatment (Hine 2007:7).

Although any physical restraint may be viewed as 'cruel' and may cause distress to the patient and her or his family (Hine 2007:9; Nirmalan, Dark, Nightingale & Harris 2004:791; Martin et al. 2002:294), it is important to be made aware that in most PICUs physical restraints are used only when "deemed necessary and whenever both pharmacological and non-pharmacological interventions had proved unsuccessful in ensuring patient safety" (da Silva et al. 2008:1210).

There are currently four types of physical restraints used in the PICU.

- **Soft wrist restraining therapies** are used to tie the arms loosely to the bed frame so that even though the trunk and legs are relatively free to move, the paediatric patients are unable to use their arms (da Silva et al. 2008:1210; Nirmalan et al. 2004:790).
- **Chest or waist restraints** allow the patients to move their legs but prevent them from using their arms and pulling at tubes and lines (Signorelli 2012:522; Hine 2007:7).
- **'Boxing gloves' or mittens** are used to wrap the hands in bandages to prevent free use of the fingers (Signorelli 2012:522; Hine 2007:7; Nirmalan et al. 2004:790).
- Another form of restraining involves **weighing down the limbs** by placing pillows on top of them and moving the paediatric patient's hand away from invasive devices (Hine 2007:7).

Other techniques for securing the tracheal tube include placing two strips of adhesive H- or Y-shaped tape on the cheek. According to da Silva et al. (2012:9), Urden et al. (2002:147) and Veldman et al. (2006:969) this is the conventional technique. In the late nineties, Sessler (1997:143), posited that improving the stabilisation of the tracheal tube is more likely to result from scrupulous attention to and close

monitoring of the tube and securing device rather than the use of specific tape per se. Since the beginning of the 21st century, various reviewed studies indicated the Hollister oral tracheal attachment device and comfort tracheal tube holders have been used (Richmond, Jarog & Hansen 2004:33). One of the quality improvements reported was the standardisation of selected procedures to minimise tube displacement (da Silva et al. 2012:1241; Rachman & Mink 2012:618; da Silva et al. 2008:1213).

2.5.2 Chemical restraints

Chemical restraints are any medication used for the specific purpose of restricting the patient's movement; but, this is not a standard treatment for paediatric patients' medical or psychiatric conditions (Hofso & Coyer 2007:250; Martin et al. 2002:299). Sedation and analgesics are commonly used either separately or in combination with physical restraints to minimise the risk of unplanned extubation (Rachman & Mink 2012:618). Children admitted to the PICU receive analgesic and sedative drugs during their stay in the intensive care unit to facilitate a procedure or test to reduce pain and anxiety associated with other therapies such as mechanical ventilation (Hartman et al. 2009:246). The analgesics and sedatives "decrease oxygen consumption, modulate the intensity of the stress response, and foster patient safety in a potentially dangerous PICU environment by reducing risks of agitation-related injury" (Deeter et al. 2011:683). While unplanned extubation is a familiar occurrence in the PICU, there is no agreed upon strategy for its prevention (Tanios Epstein, Livelio & Teres 2010:561).

Patients (including paediatric patients) should be monitored for the development of complications from restraining therapies every 2 to 4 hours and observations documented in the medical record. Unplanned extubation can be reduced if the patient is deeply sedated and restrained (Sessler 1997:143). According to Newth et al. (2009:2), chemical restraints over sedation can depress the respiratory centre which can leave the child under sedation restless; consequently, more unplanned extubation can occur.

Only the types of chemical restraints most often used in the PICU where the study was conducted are discussed. These include morphine sulphate, midazolam and neuromuscular blockers.

2.5.2.1 Morphine

Worldwide, morphine is the most commonly used opioid in the PICU for both maintenance and breakthrough analgesia (Playfor et al. 2008:89). Morphine is used to relieve pain during patient care and regional anaesthesia. It has a relatively long duration of action (for approximately two hours after administering a single dose of 0.1 mg/kg) and administration is either through continuous infusion or boluses (Miller et al. 2010:798; Playfor et al. 2008:89). The side-effects of Morphine can include papillary dilatation, sweating, hypertension, pyrexia, vomiting and behavioural changes (Jenkins et al. 2007:679; Playfor et al. 2006:1129).

2.5.2.2 Midazolam

Midazolam is the benzodiazepine commonly used in PICU as sedative agents (Ista, de Hoog, Tibboel & van Dijk 2009:2514). Midazolam is the shortest elimination half-life of the benzodiazepine group. It has a relatively short duration of action – the time to peak sedation is 5 to 10 minutes with duration of action 30 to 120 minutes (Miller et al. 2010:845; Playfor 2008:88). It should be given by continuous infusion. It can be given orally and intranasal. Midazolam is associated with the following adverse effects: death, severe intraventricular haemorrhage or per ventricular leukomalacia (Hall & Shbarou 2009:3). The side effects of hypotension may occur with bolus administration and intravenous administration as well as withdrawals after prolonged administration (da Silva et al. 2012:1242; Playfor 2008:88).

Sedation protocols were found in all studied literature research sources in which the effectiveness of unplanned extubation prevention strategies was assessed (Rachman & Mink 2012:618; da Silva et al. 2008:1210; Popernack, Thomas & Lucking 2004:59; Sadowski et al. 2004:629). Although the results obtained after the utilisation of the Penn State Children's Hospital Sedation Algorithm require further validation (Popernack et al. 2004:58), the current evidence demonstrates that sedation protocols should be included to provide objective measurement of paediatric sedation during mechanical ventilation (Playfor et al. 2006:1131).

Unplanned extubation can be reduced if the patient is deeply sedated and restrained; however, this may indeed prove detrimental to the patients with a subsequent delay in extubation (Sessler 1997:144). Inadequate sedation and analgesia may increase the risk of unplanned extubation (Birkett et al. 2005:67; Balon 2001:98). The effective use of analgesics and sedatives can reduce agitation and act as an alternative to the use of physical restraints (Bai & Hsu 2012:141; Maccioli et al. 2003:2671).

2.5.2.3 Neuromuscular blockers

To reduce unplanned extubation, neuromuscular blockers or steroidal neuromuscular blockers indications are used to facilitate mechanical ventilation when there is high ventilator settings and difficult oxygenation problems in the PICU (Deeter et al. 2011:687). Paralytics are used when the sedation fails (Popernack et al. 2004:59). The most commonly used neuromuscular blockers in the PICU are vecuronium, pancuronium and rocuronium (Jenkins et al. 2007:677). Pancuronium is a potent neuromuscular blocking drug with both vagolytic and butyl cholinesterase-inhibiting properties. A 0.08 mg/kg dose is long acting. The side effects are tachycardia and renal elimination (Kliegman et al. 2011:321; Miller et al. 2010:869). Vecuronium is the N-demethylated derivative of pancuronium in which the 2-piperidine substituent is not methylated. It is intermediate-acting at a dose of 0.1 mg/kg. The side effects are renal elimination and tachycardia (Miller et al. 2010:869).

According to da Silva and de Carvalho (2010:292), the sedation protocol recommends the level of sedation should be regularly assessed and documented using a sedation assessment scale and, whenever possible, a paediatric scoring system such as the COMFORT scale. Doses of sedative agents should be titrated to produce the desired level of sedation (Playfor 2008:89). The COMFORT scale was originally developed to assess distress in paediatric patients in the PICU (Nievas, Spentzas & Bogue 2013:1; Bai & Hsu 2012:143; Ista et al. 2009:2512).

2.5.3 Monitoring effectiveness of chemical restraints

The COMFORT scale utilises eight measured parameters: i) alertness; ii) calmness; iii) agitation; iv) physical movement; v) muscle tone; vi) facial tension; vii) mean arterial blood pressure; and viii) heart rate and respiratory response. On the

COMFORT scale, a score of 8 means 'deeply sedated' and a score of 40 represents 'alert and distressed' (da Silva et al. 2008:1210). The COMFORT scale seems to be the most practical scoring system used for paediatric patients in the PICU while the RAMSEY scale is the sedation scoring system mostly used in the adult intensive care setting (Playfor et al. 2006:1131).

Therefore, a paediatric sedation protocol can significantly decrease days of benzodiazepine and opiate administration and such a protocol may improve PICU resource utilisation, decrease PICU length of stay, and decrease days of mechanical ventilation (Deeter et al. 2011:684). However, for achieving success Twite et al. (2004:251) warns a paediatric sedation protocol should include the slow weaning of the drugs to prevent withdrawal systems occurring in paediatric patients.

2.5.4 Ethical and legal considerations

Ethical concerns are related to all patients' right to autonomy and dignity. On the other hand, the right to a safe working environment has been raised as an ethical justification for restraining disorientated and aggressive patients (Maccioli et al. 2003 :2665). This argument is strengthened by Mohr (2010:4-8) who posits that the use of restraints to prevent unplanned extubation versus the code of ethics in the PICU environment seem to present a dilemma. Hine (2007:7) cites the Nursing and Midwife Council 2004 Code of Professional Conduct stipulation which informs that the use of physical and chemical restraints is complicated by a professional obligation to ensure that the patients' freedom, dignity and autonomy are maintained. The use of physical and chemical restraints is complicated by a professional obligation to indeed assure that patients' freedom, dignity and autonomy are maintained.

Every two hours the nurse practitioner should remove the physical restraints, perform a massage and a range of motion exercises on the restrained joints and document all observations of the restrained area (Chang et al. 2008:410). Education for all staff regarding chemical, physical and psychological restraints must encompass training and competency programmes in the PICU. An audit of restraining techniques should be implemented to inform practice (Signorelli 2012:523; Bray et al. 2004:199-202).

2.6 CONCLUSION

Unplanned extubation is a potentially life-threatening event and is often the cause of reintubation which increases the possibility of tracheal injury and VAP. In addition, it leads to unnecessary stress and anxiety for both the paediatric patients and their families which inevitably result in the patients suffering avoidable complications, an increased stay in hospital with subsequent high financial implications for the family, the hospital and the government.

Chapter 3 provides an in-depth discussion on the research design and methods used to address unplanned extubation of the critically ill paediatric patient in a selected PICU in Gauteng.

3 RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

Chapter 2 provided an in-depth literature review as it applied to this study. Chapter 3 contains a detailed discussion of the research design and methods used to address the study aim and objectives.

3.2 RESEARCH AIM AND OBJECTIVES

The overall aim of this study was to plan and implement a learning event to decrease the incidence of unplanned extubation in the PICU.

The objectives were to:

- assess the incidence of unplanned extubation in a selected PICU (pre-test)
- develop and implement a co-constructed learning event in the selected PICU, and to
- re-assess the incidence of unplanned extubation in the selected PICU following the implementation of the learning event (post-test).

3.3 RESEARCH DESIGN

A research design refers to the overall plan for obtaining answers to the research questions (Polit & Beck 2012:58; Polit & Beck 2010:74). In addition, Burns and Grove (2009:218) define the research design as the blueprint for conducting a study which is used from the identification of the problem to the final plans for data collection. The research design thus serves as the backbone of the study as stated by Polit and Beck (2010:75) since it encompasses the entire strategy for the study – from the identification of the problem to final plans for data collection (Burns & Grove 2013:195).

The research design guided the current researcher to plan and implement this three-phase study in order to answer the research question.

The research design for Phases 1 and 3 was quantitative (view Section 3.3.1.1) and in Phase 2 the design was qualitative in nature (view Sections 3.3.2).

3.3.1 Phases 1 and 3: Pre- and post-test

In Phases 1 and 3 a quantitative, retrospective and descriptive research design was used (view Sections 3.3.1.1 to 3.3.1.3).

3.3.1.1 Quantitative design

A quantitative design is defined as “an essential tool for generating knowledge in nursing science” and for providing evidence for nursing practice, education and management (Botma, Greeff, Mulaudzi & Wright 2010:82). Quantitative research is numeric information that results from some type of formal measurement which is analysed with statistical procedures (Polit & Beck 2010:17). Burns and Grove (2013:3) support the view of LoBiondo-Wood and Haber (2010:584) that a quantitative design is the process of testing relationships, differences, causes and effects, and interactions between variables. The researcher follows a logical series of steps according to a set plan of action (Polit & Beck 2012:13). In the current study the data were collected by using a structured instrument – a clinical audit checklist (view Annexure B2). Paediatric patient files were audited using this clinical audit checklist.

3.3.1.2 Retrospective design

A retrospective design is defined as a study design that begins with the manifestation of the dependent variables in the present, followed by a research for a presumed cause occurring in the past (Polit & Beck 2012:224). It is described by Burns and Grove (2013:708) as an epidemiological study in which a group of people are identified who has experienced a particular event. Retrospective study designs are important in nursing studies because a pattern of reaction to interventions is identified that influences nursing actions (Burns & Grove 2013:219). According to Amarakone and Panesar (2006:175), with a retrospective design information is

obtained from routine sources such as patient files. In this study the flow charts of all mechanically ventilated paediatric patients were audited to identify the incidence of unplanned extubation.

3.3.1.3 Descriptive design

A descriptive design is used if the researcher wants to describe the variable of interest as it naturally occurs (Botma et al. 2010:110). The purpose of descriptive research is to determine, explore, describe, and document aspects of a situation as it naturally occurs (Burns & Grove 2013:215; Polit & Beck 2008:274). This design also develops theory, identifies problems with current practice, justifies current practice, and makes judgements (Burns & Grove 2013:215).

The purpose of Phase 1 was to explore and describe the incidences contributing to unplanned extubation of the mechanically ventilated paediatric patient. The aim of this study was to decrease the incident of unplanned extubation in the PICU.

3.3.2 Phase 2: Implementation

In Phase 2 a qualitative research design was used. LoBiondo-Wood and Haber (2010:584) as well as Polit and Beck (2008:17) refer to the qualitative research method as the study of human experiences often conducted in natural settings and data are used in words. For the purpose of this study, the phenomenon had to explore collaborative plan and implement actions to address the incidences contributing to unplanned extubation of the paediatric mechanically ventilated patient in the PICU. The characteristics of a qualitative research design identified by Polit and Beck (2012:487) and supported by Brink (2006:11) were adapted for this study and are indicated in Table 3.1.

Table 3.1: Application of the characteristics of a qualitative research design

Characteristics	Application
1. Flexible, capable of adjusting to what is being learned during the data collection.	The researcher was able to gather more data from the different participants and from the paediatricians to provide a wide variety of views on the phenomenon under study.

Characteristics	Application
2. Involves a merging together of various data collection strategies.	Various data collection strategies was utilised by the researcher for example, by making use of focus group interview (FGI) sessions, and individual interviews with paediatricians as well as the auditing of the files.
3. The researcher tends to be holistic, striving for an understanding of the whole.	All data collected during the study were included in the analysis which lent itself to more complete and interesting descriptions of the phenomenon.
4. It is required from the researcher to become intensely involved; often remaining in the field for lengthy periods of time.	The researcher was one of the healthcare professionals working in the specific PICU and had an emic perspective of the phenomenon. The researcher had been working in PICU for twenty years before she initiated this study and, as such, she had gained complete understanding of the phenomenon over a long period of time. (She currently still works in the PICU.)
5. The researcher requires becoming the research instrument and uses communication.	The researcher was part of the study and was responsible for various aspects of data collection and analysis.

3.4 RESEARCH METHODS

The research methods are the techniques used to structure a study and to gather and analyse information in a systematic fashion (Polit & Beck 2010:567). As further stated by these authors, logical steps are followed according to a predetermined plan and by making use of a structured instrument to collect the data needed (Polit & Beck 2012:13).

The research methods appropriate for each of the three phases will be discussed independently as used in each phase.

3.4.1 Phase 1

The research methods used in Phases 1 (pre-test) will be discussed in terms of the unit of analysis, sampling process, data collection, data analysis, and validity and reliability.

3.4.1.1 Unit of analysis

The unit of analysis is the basic focus of a researcher's analysis (Polit & Beck 2010:570). The unit of analysis for Phases 1 and 3 of the study was document analysis as suggested by Botma et al. (2010:123). The unit of analysis was the flow charts of mechanically ventilated paediatric patients in the selected PICU in Gauteng.

3.4.1.2 Sampling process

The steps followed during the sampling process are summarised in four steps and was adhered to rigorously.

- **Step 1:** The researcher identified all the mechanically ventilated paediatric patients by reviewing the admission book in the PICU for the previous two months (1 January 2014 to 28 February 2014).
- **Step 2:** The chief executive of the hospital gave the researcher permission to obtain the files of the mechanically ventilated patients from the clerk at the patient records division.
- **Step 3:** The researcher was seated in the patient records office and numbered each of the files selected according to the admission date numerically from 1 to 37. The numbers correlated with the number appearing on the clinical audit checklist, and the patient remained anonymous.
- **Step 4:** All the data obtained from patients' files were documented on the clinical audit checklist (view Annexure B).

3.4.1.3 Data collection process

Data were collected by means of a clinical audit checklist (view Annexure B). An audit is defined by Gerrish and Lacey (2010:527) as "a rigorous procedure for measuring and improving the quality of care or clinical outcomes against an agreed

standard”. The clinical audit checklist (view Annexure B) items were derived from literature, and developed by the researcher in collaboration with the supervisors and a statistician. Polit and Beck (2010:502) state an audit involves scrutinising of the data and relevant supporting documents by an external reviewer. In this study the researcher acted as the external reviewer and audited all the flow charts to determine the incidence of unplanned extubation of the mechanically ventilated paediatric patients in the specific PICU in Gauteng.

The clinical audit checklist consisted of four sections:

- **Section A:** Audit number and date
- **Section B:** Demographical information
- **Section C:** Unplanned extubation
- **Section D:** Complications following unplanned extubation

All four sections consisted of closed-ended questions. A closed-ended question is defined as “a question that offers respondents a set of predetermined response options” (Polit & Beck 2012:721). Closed-ended questions are more difficult to construct than open-ended ones but the former are more effective and easier to analyse (Polit & Beck 2010:343). The researcher’s decision to use closed-ended questions was based primarily on the fact that they are easier to answer in a short amount of time, which is consistent with the view of Polit and Beck (2012:298).

A summary of the Closed-ended questions included in the clinical audit checklist (view Annexure B) are:

- **Section A:** Consisted of two closed-ended questions to indicate the data and the number of the clinical audit.
- **Section B:** Consisted of three (3) closed-ended questions pertaining to the demographical data of the patient in terms of age, gender as well as the date of admission and the length of stay in the PICU.
- **Section C:** Consisted of five (5) closed-ended questions pertaining to the incident of the unplanned extubation: the nurse-to-patient ratio, date, time and reason for the incident as well as the chemical and physical restraints utilised before it and the procedures/interventions done during the unplanned extubation.
- **Section D:** Consisted of five (5) closed-ended questions relating to complications that the patient developed due to unplanned extubation incident.

The clinical audit checklist was first piloted before collecting data.

⇒ **Pilot study**

A pilot study is as smaller version of a proposed study conducted to develop or refine the clinical audit checklist as suggested by Burns and Grove (2013:703) as well as Polit and Beck (2012:195). Prior to the data collection of Phase 1 (pre-test), a pilot study was done using five (5) flow charts of mechanically ventilated patients to test the audit tool. The clinical audit checklist did not need to be changed, adapted or added to after the pilot study.

⇒ **Data collection**

The researcher had retrospectively audited a total number of 37 flow charts; these were inclusive of all the mechanically ventilated patients over a period of two months (from 1 January 2014 to 28 February 2014). The flow charts of the paediatric patients were audited to determine the factors contributing to the incidence of unplanned extubation in the PICU (view Annexure B).

3.4.1.4 Data analysis

Polit and Beck (2012:725) define data analysis as “the systematic organisation and synthesis of research data as well as the testing and using of that data”. A statistical

analysis of the data collected by means of the clinical audit checklist was done in collaboration with the statistician of the Department of Statistics, University of Pretoria. The descriptive data provided a description of the incidence of accidental extubation by means of percentages (%). The contributing factors identified were utilised to collaboratively develop and implement the learning events for the healthcare practitioners in the PICU (Phase 2; view Section 3.3.2).

3.4.1.5 Validity and reliability

The validity and reliability of the clinical audit checklist were ensured by adhering to the principles discussed.

⇒ Content validity

Botma et al. (2010:174) and Burns and Grove (2009:377) explain to ensure content validity, the instrument should measure what it is intended to measure. Content validity was ensured by asking two paediatricians and three paediatric clinical specialist nurses to judge each of the items included in the clinical audit checklist. The aim of the clinical audit checklist was to identify factors contributing to unplanned extubation of the mechanically ventilated paediatric patients in the PICU.

⇒ Reliability

Polit and Beck (2012:175) support Burns and Grove's (2009:222) definition that reliability is "the degree of consistency of dependability with which an instrument measures an attribute". All the clinical audits were done by the researcher; this increased the consistency of the data collected as well as the findings relating to the factors contributing to the incidence of unplanned extubation of the mechanically ventilated paediatric patient.

3.4.2 Phase 2

The objective of Phase 2 was to develop a co-constructed learning event for implementation in the PICU. The research methods used are discussed in Sections 3.4.2.1 to 3.4.2.5.

A learning event is the joined description of the paradigms of a learner's activity and the researcher activity; it can be complementary and interdependent in a learning

situation (Leclercq & Poumay 2005:1). In the current study the learning event was collaboratively developed and implemented by the researcher, unit manager and the healthcare professionals (critical care nurses and paediatricians). The value and importance of a learning event (or learning events) are supported by da Silva and de Carvalho (2010:288). These authors report significant reductions in the unplanned extubation rate after the implementation of educational programmes. Their findings validate the value of a learning event or intervention as best practice in a PICU in which unplanned extubation in paediatric critically ill patients is a critical problem.

3.4.2.1 Population

The population for Phase 2 included all healthcare professionals (nurses, physiotherapists and paediatricians) who were involved in the management of mechanically ventilated paediatric patients in the PICU.

The eligibility criteria for the sample (Polit & Beck 2008:338) prescribed they had to be full-time healthcare professionals involved in the management of mechanically ventilated paediatric patients. The sample included:

- nurses
- physiotherapists
- paediatricians.

3.4.2.2 Sampling

Purposive sampling was used to identify participants. In purposive sampling the researcher selects specific participants to include during the data collection (Burns & Grove 2013:365). Criteria for selection is based on the participants' knowledge and insights about the phenomenon identified (Polit & Beck 2008:343). The number of years the healthcare professionals worked in the PICU ranges from 1-32 years.

3.4.2.3 Data collection

The data were collected by means of a focus group interview (FGI). According to de Vos, Strydom, Fouché and Delport (2011:360), conducting a focus group interview is a solid and thorough way to obtain a deeper understanding of how people feel and/or think about an issue (in this case, the factors contributing to accidental extubation). Burns and Grove (2013:274) also assert a focus group interview provides an ideal

opportunity for generating relevant and in-depth data through the sharing of ideas and information in a group with a similar goal in mind. In this study, the goal the FGI aimed for was to suggest strategies to be included in the learning event. De Vos et al. (2011:366) state focus groups usually include six to 10 participants whereas in the opinion of Brink et al. (2007:152), an FGI should comprise between five to 15 people who have all been exposed to the same environment and whose perceptions, experiences and opinions are requested simultaneously.

The various advantages of an FGI noted by Bowling (2007:394) and de Vos et al. (2011:360) were well suited to the purpose of Phase 1 of the current study.

- The FGI encouraged participants to develop a learning event for the prevention of accidental extubation based on their experience in the PICU.
- The researcher was able to access a large number of participants at one time.
- It gave the participants an opportunity to discuss, brainstorm, formulate and modify their views and make sense of their experiences.
- The participants could respond and build upon answers, ideas and suggestions of other participants.
- The FGI made allowance for various communication methods thereby catering for a wide range of different forms of experiences to be exposed, shared and discussed by the participants.

The researcher invited all healthcare professionals to participate voluntarily in the FGI, by means of a formal invitation (view Annexure C1). The invitation provided information such as the date, time and venue for the FGI. The participants attended the FGI in their off-duty time. This meant that utmost consideration was given to make sure the delivery of patient care in the PICU was not compromised.

The venue was identified as suitable as it was secluded. It provided for a quiet, comfortable and non-threatening environment in which the participants felt at ease to collaboratively develop a learning event. Conducting an FGI in a safe and non-judgemental environment promotes an in-depth discussion of the topic (Burns &

Grove 2013:274). Refreshments were provided and chairs and tables arranged in such a way that the participants were seated in a circle.

Based on the fact that the researcher was working as a nurse in the PICU, an independent facilitator was used to conduct the FGI. The researcher explained the rationale for the FGI and emphasised that participation was voluntary (view Annexure C2). Once the participants had been informed of the content of the information leaflet and had signed the participant information form, the independent facilitator officially opened the FGI (Streubert & Carpenter 2007:62). The independent facilitator set ground rules for the session and then the researcher gave feedback on the findings of Phase 1 (view Annexure C3).

Curtis and Redmond (2007:30) emphasise the importance of having a skilled, experienced and independent facilitator to maintain objectivity, ensure a smooth and valuable group interview session as this will enhance the quality of the data. The independent facilitator used in this study is a skilled and experienced professional. She holds a doctoral degree and facilitated numerous FGIs on previous occasions. Asking open-ended, relevant questions to obtain rich data was critical (Polit & Beck 2012:736). The main questions asked during the FGI are set out below.

- *How do you think the factors contributing to unplanned extubation can be addressed in the PICU?*
- *What specific actions can you suggest we implement to decrease unplanned extubation in the PICU?*

The discussion during the FGI was guided by the four main contributory factors to unplanned extubation identified during Phase 1, namely:

- ineffective sedation
- inappropriate physical restraints
- in proper secured endotracheal tube
- insufficient knowledge and skills of healthcare professionals

The following skills were used during the FGI to encourage participation and obtain rich data. The specific skills used by the independent facilitator to extract additional information included probing, reflection, clarification listening skills and paraphrasing:

- **Probing:** the purpose of probing is to elicit more useful or detailed information from a research participant during an interview (Polit & Beck 2006:792). In this study probing helped to reach consensus pertaining to the content, structure and implementation of the learning events. Probing was also used to encourage participants to give more information about the issue under study (De Vos, Strydom, Fouché & Delport 2005:290). The independent facilitator followed up with questions about the participants' comments to gain more clarity and meaning. Brink et al. (2006:153) support the notion that probing enhances rapport because it proves to the participants the researcher (independent facilitator in this study) is interested in their experiences and, secondly, it provides the researcher (in this case the independent facilitator) with the opportunity to seek clarification. For example, in the current FGI the independent facilitator had to use probing to clearly understand what was meant when different types of presentations were requested. She structured the follow-up question as follows: *'Explain exactly what do you mean if you say you want different types of presentations.'*
- **Reflection:** this is the process during which the researcher (independent facilitator) repeats the participant's thoughts and feelings to check whether it was well understood. Following the advice of De Vos et al. (2005:290), the current independent facilitator repeated some key words with the purpose of stimulating the participants to give more information; for example: *'When do you think will be the best time to have the in-service training sessions?'*
- **Clarification:** is the technique used to gain clarity on some statement. The researcher will ask questions in order to gain clarity on the phenomenon under study (De Vos et al. 2005:290). An example would be when the independent facilitator clarified the suggestion that a few people should be involved in the presentation of the learning event as follows: *'You mention that more than one person should be involved in presenting the learning events? Who do you think should be involved?'*

- **Listening skills:** the most critical interview skill in terms of in-depth interviews is “being a good listener, it is especially important not to interrupt the participants. It is the job of the interviewer to listen to the participants’ stories” (Polit & Beck 2006:792). The current independent facilitator made a point of listening carefully and attentively to what the participants had to say. Her attentiveness she demonstrated by uttering encouraging sounds such as ‘mmm’ or ‘u-hum’ as well as nodding her head to show her further interest in the discussion. Since she is experienced and skilled, she was able to incorporate their body language to fully grasp and understand the finer meaning behind the participants’ words. The use of these listening skills enables the facilitator to maintain continuous interaction with the participants and to obtain clarity and meaning regarding their perceptions (Terre Blanche, Durrheim & Painter 2006:306).
- **Paraphrasing:** takes place when the researcher repeats the words of the participants in another way but with the same meaning (Burns & Grove 2011:109). At the end of the current FGI the independent facilitator summarised and validated what the participants had said to make sure she had understood them correctly. She subsequently made sure the participants had reached consensus by ascertaining whether all agreed about the type of learning events as well as the structure and implementation plan for the agreed upon learning events. Finally, the independent facilitator made field notes about her personal experiences during the FGI and the observations she had made during the facilitation of the FGI as suggested by Terre Blanche et al. (2006:300) and Rossouw (2003:146).

At the end of the FGI the researcher briefly summarised the main points obtained from the interview session and expressed her gratitude for their participation. The researcher asked permission to contact the participants (should he need arise) to confirm findings or clarify some details (Terre Blanche et al. 2006:300). Once the participants had left the venue, the independent facilitator and researcher reflected on the FGI session and discussed the outcome.

3.4.2.4 Data analysis

LoBiondo-Wood and Haber (2010:274) describe content analysis as the method of analysing narrative or word responses to questions and grouping the responses into themes or categories. For the purpose of this study, content analysis was done in accordance with Creswell's (2003:191) advised six steps.

- **Step 1** was to organise and prepare the data were for analysis. This involved transcribing, sorting and arranging the data into different categories depending on the sources of information.
- **Step 2** involved reading through the data to obtain the general sense of the information and to reflect on its overall meaning. The researcher read through all the transcribed data to gain a general sense of the information provided by the participants. This information (data) focused on the actions the participants believed needed to be taken to develop a learning event to decrease unplanned extubation of the mechanically ventilated paediatric patient.
- During **Step 3** the coding process was initiated. According to Creswell (2003:192), coding refers to organising the obtained data into 'chunks' attaching meaning or giving meaning to these 'chunks'. Tesch (1990) cited by Creswell (2003:142-145) proposes eight steps for the coding process. The current researcher followed these eight steps when she coded the data.

- She read through all the transcriptions carefully to get a sense of the whole.
 - The researcher shoes the shortest, most interesting document and read through it to get the underlying meaning. The same process was repeated with several documents and she wrote down her thoughts and ideas about each in the margins.
 - She then made a list of all the possible topics derived from the analysed documents.
 - She clustered similar topics together.
 - The topics were then abbreviated as codes next to the appropriate segments of the texts.
 - The researcher decided on the most descriptive wording for each topic.
 - Next, the topics were turned into categories.
 - A reduction of the total list of categories was then constructed by grouping topics that related to each other together.
- In **Step 4** the coding process was used to generate descriptive themes and categories.
 - In **Step 5** the researcher proceeded with the description of the themes and associated categories.
 - In **Step 6**, the final step, meaning was given to the data. Reflective quotes and a discussion of related literature were used to support the emerging themes and categories.

3.4.2.5 Trustworthiness

Polit and Beck (2012:745) write trustworthiness refers to the “degree of confidence qualitative researchers have in their data”. It is these authors’ stance that the strategies to enhance trustworthiness of a qualitative study flow throughout the research study (Polit & Beck 2010:492; 2008:538-539). Lincoln and Guba’s (1985) (cited by Polit & Beck 2012:745) criteria for trustworthiness attend to credibility, dependability, transferability, conformability, and authenticity.

⇒ Credibility

Credibility refers to having confidence not only in the truth of the study data but also in the truthful interpretations of the data (Polit & Beck 2012:175; 2010:492). Qualitative researchers have a responsibility to establish credibility in the truth of the study findings (Lincoln & Guba [1985] cited by Polit & Beck 2010:492; Polit & Beck 2008:539).

In a research study, credibility involves two aspects. Firstly, carrying out the study in a way that enhances the believability of the findings and, secondly, keeping a detailed record of the steps taken to demonstrate credibility to the external readers. In this study, credibility was further enhanced by the researcher's extended knowledge regarding the study context and phenomenon because she had worked in the particular PICU as a professional nurse for 10 years before the study was conducted. Prolonged engagement enhances the credibility of the research findings. Furthermore, the researcher collected data during all Phases (1, 2 and 3) of the study and therefore spent sufficient time to have an in-depth understanding of the factors contributing to unplanned extubation of mechanically ventilated paediatric patients in the specific PICU.

⇒ Dependability

Dependability means "the stability (reliability) of data over time and over conditions" (Polit & Beck 2012:585; 2010:492). In this study, a thick description of the data gathering methods and data analysis were presented. Polit and Beck (2012:585; 2010:492) insist themes and categories identified during the data analysis process need to be scrutinised and validated by at least two or more independent professionals to confirm the accuracy, neutrality, and relevance of the meaning and understanding the researchers attached to the obtained data. In this study, the researcher attempted to rigorously make sure the findings reflected the voice of the participants and the conditions of the inquiry, and not the biases, motivations or perspectives of the researcher herself (Polit & Beck 2012:585; 2010:492). The participants who participated in the FGI were involved to confirm the research findings.

⇒ **Transferability**

Transferability reflects the extent to which the findings from the data can be transferred to the other settings or groups; in other words, transferability implies generalisability (Polit & Beck 2012:585; 2010:492). Lincoln and Guba (1985) (cited by Polit & Beck 2008:539) view transferability as the responsibility of the researcher to produce an in-depth description of the research process in the research report so that other researchers can use a similar process in other contexts.

⇒ **Authenticity**

Holloway and Wheeler (2010:304) as well as Polit and Beck (2012:585) state authenticity refers to the degree to which the documented findings represent a truthful reflection of the participants' views. The research report portrays the participants' language relating to the inputs provided during the data collection process.

3.4.3 Phase 3

The research methods used in Phase 3 (post-test) were similar to the research methods used in Phase 1 and are therefore not duplicated. View Section 3.4.1 for a detailed description of the unit of analysis, sampling, data collection, data analysis as well as the validity and reliability used.

3.5 SUMMARY

Chapter 3 focused on the research design and methods used to address the research question, aim and objectives. The strategies to establish rigour in Phases 1 to 3 were discussed. Chapter 4 is a discussion of the research findings and the interpretation thereof in relation to relevant literature and verbatim transcribed quotes.

4 STUDY FINDINGS

4.1 INTRODUCTION

In Chapter 3 the research design and methods used to address the aim and objectives set for the study were attended to thoroughly. In this chapter the researcher will present an in-depth discussion of all three phases of the study findings and validating it by means of some verbatim quotes and related literature.

4.2 OVERVIEW OF FINDINGS

The study consisted of three phases and the findings of each phase will be discussed individually. During Phase 1 a pre-test was conducted to determine the incidence of unplanned extubation by using a clinical audit tool (view Annexure B). In Phase 2 a collaborative learning event was planned in an FGI and implemented based on the findings from Phase 1. In Phase 3 a post-test was conducted using the clinical audit tool (view Annexure B) to determine whether the incidences of unplanned extubation decreased following the implementation of the learning events.

4.3 PHASE 1: PRE-TEST

In Phase 1 the researcher collected the data using the clinical audit tool (view Annexure B). The researcher was assisted and supervised by personnel in the record department of the particular hospital to identify the relevant patient files and to ensure the security of the files as well as the confidentiality of the patients. The researcher retrospectively conducted the clinical audits using the flow charts of all mechanically ventilated paediatric patients managed in the PICU over a period of two months (from 1 January 2014 to 28 February 2014). During this timeframe a total number of 37 mechanically ventilated paediatric patients were managed, reflecting the incidence rate of unplanned extubation as a very high 37% (14 incidences of unplanned extubation occurred). This is significantly higher than the acceptable international incidence rate (3% to 14% per 100 ventilation days) for unplanned

extubation of the paediatric patients in the PICU (Rachman & Mink 2012:614; Birkett et al. 2005:66; Yeh et al. 2004:255).

The research findings will be discussed as it relate to the items identified in the clinical audit tool (view Annexure B).

4.3.1 Section A: Demographic information (N=14)

A total of 14 (N=14) incidences of unplanned extubation were evidenced. Nine (n=9; 64.2%) paediatric patients were male and five (n=5; 35.7%) were female. The patients' ages ranged from two months to four years and 10 months with an average age of one year and two months.

4.3.2 Section B: Incidences (N=14)

The majority (n=10; 71.4%) of unplanned extubation occurred during the day shift (07:00 to 19:00) and four (n=4; 28.5%) occurred during the night shift (19:00 to 07:00). The nurse-to-patient ratio during the incidences of unplanned extubation were 1:1 in six (n=6; 42.8%) and 1:2 when eight (n=8; 57.1%) incidences occurred. Of the 14 (N=14) incidences of unplanned extubation, 10 (n=10; 71.4%) required reintubation and four (n=4; 28.5%) did not require reintubation.

4.3.3 Section C: Chemical restraints (N=14)

Of the 14 (N=14) incidences of unplanned extubation, two (n=2; 14.2%) paediatric patients received Morphine Sulphate®; seven (n=7; [50%]) paediatric patients received Midazolam®; one (n=1; 7.1%) received Pancuronium® (Pavulon); three (n=3; 21.4%) paediatric patients received Morphine Sulphate® and Midazolam®; and one (n=1; 7.1%) paediatric patient received Pancuronium® and Morphine Sulphate®.

4.3.4 Section D: Physical restraints (N=14)

At the times when the 14 (N=14) incidences of unplanned extubation occurred, eight (n=8; 57.1%) paediatric patients were restrained while six (n=6; [42.8%]) were not. Five (n=5; 35.7%) paediatric patients' endotracheal tubes were secured with plaster only. The endotracheal tubes of the remaining (n=9; 64.2%) were secured with plaster and Friars Balsem® (TB Co). Of the 14 (N=14) incidences of unplanned

extubation, 11 (n=11; 78.5%) of the paediatric patients' ventilator circuits were secured while three (n=3; 21.4%) were not secured.

Unplanned extubation mainly occurred during the following procedures as evidenced in the data derived from the paediatric patients' flip charts:

- tracheal suctioning (n=2; 14.2%);
- securing of the tracheal tube (n=1; 7.1%);
- bed bath (n=2; 14.2%);
- changing the patients' position (n=2; 14.2%);
- physiotherapy (n=3; 21.4%);
- X-rays (n=1; 7.1%).

Three (n=3; 21.4%) of the six paediatric patients who were not restrained extubated themselves.

4.3.5 Section E: Complications (N=14)

Seven (n=7; 50%) of the paediatric patients presented with more than one complication. Stridor presented as a complication following unplanned extubation in nine (n=9; 64.2%) paediatric patients; four (n=4; 28.5%) of the paediatric patients presented with pulmonary arrest, six (n=6; 42.8%) with cardiac arrest and two (n=2; 14.2%) of the paediatric patients died.

4.4 PHASE 2: DEVELOPMENT AND IMPLEMENTATIONS OF LEARNING EVENTS

The objective of Phase 2 was to develop a co-constructed learning event for implementation in the paediatric intensive care unit (PICU). Phase 2 encompassed two steps. During Step 1 an FGI was conducted with healthcare professionals to develop preliminary learning events to address the incidence of unplanned extubation of the mechanically ventilated paediatric patient. During Step 2 the preliminary planned learning event was presented to all the healthcare professionals working in the PICU to collaboratively refine and implement the learning events.

Step 1: Preliminary development of learning events

The first step to develop the learning event was done by means of a focus group interview (FGI). The researcher invited all the healthcare professionals (doctors, nurses and the physiotherapist) involved in the management of mechanically ventilated paediatric patients in the PICU participate in the FGI. Twenty-three (23) participants (of which 22 were professional nurses and one was a physiotherapist) willingly agreed to take part in the FGI. The doctors indicated due to their busy work schedule and patient responsibilities they would be unable to attend an FGI, but emphasised their willingness to give input and collaborate with the researcher during the planning and implementation of the learning events. A total of 15 professional nurses had obtained additional qualifications and seven (7) only had experience in the management of mechanically ventilated paediatric patients. The 23 participants' years of experience in the PICU ranged from 1 to 32 years, with an average of 10.6 years. In Table 4.1 a summary of the additional qualifications of the professional nurses who participated in the FGI is provided.

Table 4.1: Summary of additional qualifications of professional nurses

Additional qualification obtained	Number of professional nurses
Child nursing	3
Critical care: Adult and Paediatric	4
Neonatology	1
Critical care: Adult	7
Total	15

Before beginning with the FGI, the researcher presented the results of Phase 1 (pre-test) to the participants (view Annexure C3). Following the presentation the question posed to the participants was:

'Which strategies can you suggest should be implemented to decrease the incidence of unplanned extubation in the PICU?'

During the FGI the participants indicated the learning events should only focus on two of the identified contributing factors identified during Phase 1.

Consensus was reached to plan strategies relating to address *inappropriate physical restraints* and *ineffective sedation*.

Table 4.2: Summary of the contributing factors and planned strategies

Contributing factors	Strategies
Inappropriate physical restraints	Informed consent
	Application methods: <ul style="list-style-type: none"> • patient safety • continuous patient supervision
	Rest period
	Documentation
Ineffective sedation	Medication
	Level of sedation
	Weaning from sedation

The strategies to be included in the learning events relating to inappropriate physical restraints and ineffective sedation are summarised in Table 4.2 and will be discussed in Sections 4.4.1 and 4.4.3.

4.4.1 Contributing factor 1: Inappropriate physical restraints

All participants were of the opinion the restraints were not correctly applied, there was no information available to the healthcare staff or the parents on how to assure the restraints were correctly applied to be comfortable for the patient. They further agreed information about constraints in terms of patient supervision was scarce. In fact, it seemed as if there was no standard of care available. Participants shared a well-standardised application method on how physical restraints needed to be developed, applied and its management supervised. These emerged as some of the challenges that needed be addressed to prevent unplanned extubation of the mechanically ventilated paediatric patient.

Supportive quotes:

- *“restraints must be correct and comfortable or they were not the correct size, patients could wriggle out of them and accidentally extubated themselves...”*
- *“we need a standard ... everybody does what they think is best...”*
- *“to refer to hospital standard operational procedures...”*

Discussion: Making use of physical restraints is a patient care intervention to restrict a person's freedom of movement or access to their own body (Chang et al. 2011:192; Martin & Mathisen 2005:134). Physically restraining a patient means using any manual, physical or mechanical devices, material or equipment attached to the patient's body to prevent him or her from moving freely and easily; physical restraints therefore restrict freedom of movement or normal access to one's own body (Hofso & Coyer 2007:25; Ofoegbu & Playfor 2006:409).

Various types of physical restraints can be used in the PICU. Wrist restraints are used to tie the arms loosely to the bed frame so that even though the trunk and legs are relatively free to move, paediatric patients are unable to use their arms (Nirmalan et al. 2004:790). Boxing gloves or mittens involve wrapping the hands in bandages to prevent free use of the fingers (Hine 2007:7; Nirmalan et al. 2004:790). The paediatric patient must be assessed for contraindications, for example, a physical health issue or a history of prior abuse, before attempts are made to introduce any of these restraints. Mummy restraints refer to a blanket or sheet that is folded around the child to bound her or his movement; mummy restraints are mainly used to execute procedures on the paediatric patient (Kozier & Berman 2008:736). Increase support and vigilant of health care professionals continuously. Monitor for the deliberate self harm to prevent unplanned extubation (Rudo & Xocisko 2014:293).

Physical restraints should be applied in such a way that it allows the patient to move as "freely as possible without defeating the idea of the restraint". It is important to select the correct size and type of restraint for the patient to avoid obstructing the blood flow to specific body areas (Kozier & Berman 2008:734) and to provide a range of motion every 15 minutes (Rudd & Kocisko 2014:292). Identified complications caused by physical restraints include oedema and cyanosis due to wrist and arm restraints; pressure ulcers; aspiration and breathing problems caused by sheet and belt pressure on the patient's chest; rejection of food; and suffocation by sheet fixation. Physical restraints that are too loose can lead to a patient falling out of bed which can result in, for example, a dislocated shoulder (Demir 2007:42). Five strategies were suggested pertaining to physical restraints.

4.4.1.1 *Strategy 1: Informed consent (ethical aspect)*

4.4.1.2 *Strategy 2: Application method (age specific)*

4.4.1.3 *Strategy 3: Rest period*

4.4.1.4 *Strategy 4: Documentation*

4.4.1.5 *Strategy 5: Specific recommendations.*

Each of these five categories (strategies) with its related sub-categories will be discussed. Supportive verbatim quotes from the participants as well as from literature will be given.

4.4.1.1 Strategy 1: Informed consent (ethical aspect)

During the FGI participants discussed how critical it was for parents/caregivers to have information about physical restraints and for them to sufficiently comprehend this information. They further shared it is essential for parents/caregivers to understand the importance of physical restraints and *why* they should not untie the restraints during visiting hours. Furthermore, the possible risks if the paediatric patient is not restrained should also be communicated to the parents/caregivers. The participants stressed it was also critical that parents/caregivers be given the right and time to openly ask questions and receive answers relating to the child's physical restraining before signing the informed consent form.

Supportive quotes:

- *“monitor the consent form signed both by the doctor [paediatrician] and caregiver...”*
- *“explain to the caregivers what you are going to do, why it is necessary, and how they should cooperate...”*
- *“provide for patient privacy and application of date, time and patients response to be monitored...”*
- *“information about the restraints should be given to the caregiver [or parent(s)]...”*

Discussion: Informed consent is a shared decision by the healthcare professional and patient and/or significant other to agree on suggested interventions or management (Andanda 2012:451). According to Rudd and Kocisko (2014:292) and Signorelli (2012:530), physical restraints should not be used with without a signed consent form from the patient (in the case of this study either a parent's or the

caregiver's) or without expert consultation. Physical restraining can only be done on the paediatricians' orders. Various literature sources recommend involving the paediatric patient (seven years or older), the parent(s) and/or caregiver in care planning when intending to use physical restraints (Signorelli 2012:523; Bray et al. 2004:199).

Informed consent is an ethical principle that requires the sharing of information with participants; specifically the risks and benefits involved (Signorelli 2012:523). Healthcare professionals should adhere to the ethical principle in terms of giving parents comprehensive information as regards the benefits and risks involved in physical restraints. The information provided will enable the parents to make an informed decision.

4.4.1.2 Strategy 2: Application method (age specific)

The participants believed it is important to consider the type of restraints and the effectiveness thereof. The person responsible for applying the restraints should have the appropriate knowledge about the different types of restraints available. When deciding to apply physical restraints, it is vital that the nurse should always apply age-specific restraints. An example reflected on was that mummy restraints are not appropriate for a two-year-old toddler. The mummy restraints will not keep the two-year-old patient safe as they are very busy and want to move around continuously.

Supportive quotes:

- *“allow comfortable position of physical restraints, correct type for the patient...”*
- *“the nurses must understand how to use the restraints...”*
- *“some restraints work better than others ... we [nurses] must know which restraints to use ... how it works...”*

Discussion: Different types of restraints are available to restrain paediatric patients. Bray et al. (2004:202) state a sufficient number of healthcare staff who is trained and confident to restrain these patients by using safe and appropriate techniques must be available in the PICU. For example, nurses managing the mechanically ventilated paediatric patient must know and take care that, when using the commercial thumbless mittens to restrain the hands of a paediatric patient, the fingers should be

slightly flexed. Another example: when applying restraints to the ankle or wrist of the paediatric patient, the padded portion should be around the ankle or wrist and the leg and tied in such a way that the patient cannot pull his or her hand or foot through the restraint (Signorelli 2012:522). A mummy restraint is a special folding sheet folded around young children to prevent movement during procedures and should only be used on very small babies as suggested by Kozier and Berman (2008:735).

Two additional strategies emerged with regard to the application of physical restraints: *patient safety* and *continuous patient supervision*.

⇒ ***Patient safety***

The participants raised their concerns with regard to the safety of the paediatric patient and discussed the risks involved during unplanned extubation. Emphasis was placed on the fact that healthcare professionals should stay vigilant and be on the lookout for any adverse effects that may be caused by the application of physical restraints. The participants specifically mentioned using Elastoplast for the restraints and the risk when safety pins are used to secure the restraints. Safety pins can “*cause harm*” to the paediatric patient. They mentioned possible Elastoplast allergy and the injuries that may be caused to the paediatric patient if safety pins open.

Supportive quotes:

- “*using Elastoplast and safety pins can cause harm to the [paediatric] patient...*”
- “*patient safety should be considered when restraining the [paediatric] patient ... think about their [paediatric patients'] safety, comfort and dignity...*”
- “*the pins we [nurses] use often open and there is a risk that it injures the [paediatric] patient...*”

Discussion: The primary goal for using physical restraints in the PICU is to ensure patient safety (Dye, Brown & Chhina 2009:70). As stated in the Nursing Act No. 33 of 2005 (Republic of South Africa 2005b:44), a safe environment “uses appropriate assessment tools to identify potential and actual risks for a safe environment for health care delivery ... implements procedures that maintain effective infection control...”. Hence, the application of the physical restraining device should be applied in such a way that it upholds the patient’s rights and dignity (Martin

& Mathisen 2005:133). In addition, Signorelli (2012:523) supports Bray et al. (2004:201) by advising that restraints have to be placed in such a way that the patient can move as freely as possible without defeating the original objective, namely to keep the patient safe during tracheal intubation.

Maccioli et al. (2003:2670) state the argument whether making use of Elastoplast plasters and safety pins for the dressings in the PICU remains unresolved. Yet, as indicated in the above quotes, the participants in this study reflected that it could cause harm to the paediatric patient. Signorelli (2012:523) supports the participants' concern and this author's advice is to assess the paediatric patient's skin every two hours for a rash or signs of discomfort from a safety pin. Signorelli (2012:523) also emphasises that skin care must be done during the rest period or then every two to four hours. Kozier et al. (2008:735) suggest care to back and pressure parts must be done, a range of motion exercises must be applied to the skin, optimal fluid needs to be provided to the paediatric patients, and a healthy nutritional status should be maintained.

⇒ ***Continuous patient supervision***

All the participants agreed that constant supervision is necessary to prevent unplanned extubation of the mechanically ventilated paediatric patient. Supervision should be done by all the members of the multidisciplinary team including the physiotherapist (when exercising the patient during periods of rest) and the radiographer when taking X-rays. Cooperation among all healthcare professionals will ensure constant supervision which can assist to decrease the incidences of unplanned extubation of the mechanical ventilated paediatric patient. Since the small paediatric patient's neck is flexible and the tracheal tube is uncuffed, motion of the neck can dislodge the endotracheal tube (Stewart 2006:17). Therefore, the nurse who is managing the restrained paediatric patient must be vigilant and aware at all times of the risks involved for unplanned extubation. For example, during suctioning or turning the paediatric patient, the nurse may ask the parent or caregiver to assist while explaining and demonstrating how and what should be done. However, the participants cautioned that, because unplanned extubation can occur at unexpected times, the constant supervision of mechanically ventilated paediatric patients is pivotal.

Supportive quotes:

- *“the [paediatric] patient to be always supervised to prevent unplanned extubation...”*
- *“education of nurses and caregivers to be more vigilant is important...”*
- *“everybody [healthcare professionals] should supervise and prevent unplanned extubation ... if we [healthcare professionals] all look ... the numbers will decrease...”*

Discussion: The literature reviewed recommend constant (or more frequent) supervision of the mechanically ventilated paediatric patient in the PICU (Chang et al. 2011:192). Literature supports a nurse-to-patient ratio of 1:1 is the best to ensure constant supervision (Kiekkas et al. 2012:127). Incidences of unplanned extubation can be attributed to increased PICU activity during day shifts (Bouza et al. [2007:275] cited by da Silva et al. 2008:1216) or a low level of staff vigilance at night as noted by Listello and Sessler (1994) cited by da Silva et al. (2008:1216). Supervision must be done in accordance with the policies, standards and procedures which must be clearly written, visible and revised on a continuous basis to stay updated (Signorelli 2012:524; Chang et al. 2008:410). The healthcare professionals must always remember their responsibility is to offer optimal care to society and humankind and best care to the patients (Signorelli 2012:530).

4.4.1.3 Strategy 3: Rest period

The participants emphasised the importance of ensuring there is a rest period for the restrained paediatric patient every two hours. During the rest period the restraints should be removed and the limbs of the patients massaged slightly to enhance blood flow and decrease risk for oedema. Therefore, it was deemed imperative for nursing activities to be planned to accommodate rest periods for the paediatric mechanically ventilated patients. The participating nurse practitioners asserted during the rest period the restraints should be removed under supervision and two nurse practitioners should be present to reduce the risk of unplanned extubation.

Supportive quotes:

- “[paediatric] patients should have a rest period every two hours ... remove the restraints under supervision ... it is important to supervise in order to prevent unplanned extubation...”
- “encourage cluster care to improve rest periods ... the [paediatric] patient must not be restrained the whole day ... allocate time for rest...”

Discussion: According to Signorelli (2012:523), the restraints should be removed at least every two to four hours. It is recommended that during this period the nurses should do passive exercise and skin care to improve circulation and prevent skin breakdown (Signorelli 2012:523).

4.4.1.4 Strategy 4: Documentation

Consensus was reached among the participants that the monitoring, evaluation and accurate recording of the paediatric patient’s peripheral perfusion and skin integrity are vital during the rest period. Keeping accurate records is part of quality patient care and the nurses should record all interventions and management implemented to manage the mechanically ventilated paediatric patient. This prevents the complications like cyanosis, pallor, coldness of the skin area and skin abrasion.

Supportive quotes:

- “monitoring and evaluating of peripheral perfusion is very important ... and then document the...”
- “documentation of peripheral perfusion ... and frequency of observation and patient’s response is very important...”
- “release from restraints with periodic, routine exercise and assessment for flow and skin integrity ... at the same time the nurses should monitor peripheral perfusion and document the findings...”

Discussion: The healthcare professionals should monitor and evaluate the intubated paediatric patient’s peripheral perfusion to identify impaired circulation (due to restraints) at least every two hours (Signorelli 2012:524; da Silva & de Carvalho 2010:292). The monitoring and evaluation process needs to include inspection of the patients’ skin colour, the capillary refill, the pulse of restrained extremities, movement

and sensation of extremities, and proper body alignment every four hours as suggested by Signorelli (2012:524) and Maccioli et al. (2003:2674).

4.4.2 Contributing factor 2: Ineffective sedation

The participants reflected that sedation in the PICU was challenging. Currently, there is no standardised sedation protocol for the mechanically ventilated paediatric patients; sedation is titrated and the weaning process is done haphazardly. There is no consensus among healthcare professionals regarding criteria for the weaning of sedation prior to extubation. The nurses indicated they “*feel frustrated*”; they recognised that reaching consensus among all healthcare professionals involved in the management of the mechanically ventilated paediatric patient may lead to a decrease in the incidence of unplanned extubation.

Supportive quotes:

- “we [healthcare professionals] *must sit together as a group and agree on how we are going to wean the sedation...*”
- “we [healthcare professionals] *should agree on a protocol for sedation of the [paediatric] patients...*”
- “*currently we [healthcare professionals] do as we see fit ... we give sedation as we think they need it...*”
- “we [professional nurses] *feel so frustrated ... they [paediatricians] do not agree on the type of sedation...*”

Three strategies emerged from the data relating ineffective sedation: *medication, level of sedation and weaning.*

4.4.2.1 Strategy 1: Medication

The participants voiced that the drug of choice for sedation purposes in this PICU was a midazolam. When the sedation was considered insufficient, morphine was given in addition to midazolam.

Supportive quotes

- “we [healthcare professionals] are mainly using morphine [Morphine Sulphate®] to sedate the [paediatric] patients...”
- “most of the [paediatric] patients receive morphine [Morphine Sulphate®] and dormicum [Midazolam®]...”
- “yes, we [healthcare professionals] use dormicum [Midazolam®] and morphine [Morphine Sulphate®]...”

Midazolam® is the benzodiazepine commonly used in the PICU as a sedative agent (Ista et al. 2009:2514). Midazolam® has the shortest elimination half-life of the benzodiazepine group. It has a relatively short duration of action; the time to peak sedation is 5 to 10 minutes with action duration of 30 to 120 minutes (Miller et al. 2010:845; Playfor et al. 2006:1131). Hypotension may occur with bolus administration and withdrawal symptoms following prolonged administration (Playfor et al. 2008:89).

Worldwide, Morphine Sulphate® is the most commonly used opioid in PICUs for both maintenance and breakthrough analgesia (van Dijk & Tibboel 2012:1168). Morphine Sulphate® is used to relieve pain during patient care and regional anaesthesia. It has a relatively long duration of action (around two hours) when administered as a single dose of 0.1 mg/kg and is administered either through continuous infusion or boluses (Miller et al. 2010:798). The signs of side effects of morphine include papillary dilatation, sweating, hypertension, pyrexia, vomiting, and behavioural changes (van Dijk & Tibboel 2012:1168; Jenkins et al. 2007:679).

4.4.2.2 Strategy 2: Level of sedation

The participants shared that the level of sedation was not monitored in the PICU. Medication was either titrated or given as boluses without assessing the level of sedation – there was simply no consistency as regards the consistency of the sedation level. Participants also confirmed they had observed a continuous titration of sedatives appears more effective than bolus dosages. They were in agreement that it was vital to collaborate with the paediatricians to identify a way in which to assess the level of sedation of the mechanically ventilated paediatric patient.

Supportive quotes:

- *“promote regular assessment of [paediatric] patient’s level of consciousness ... we [healthcare professionals] should all use the same instrument...”*
- *“everybody is assessing the level of sedation different...”*
- *“How often do you review the dose and type of the sedation if not effective...?”*

Discussion: Sedation and pain management are common practices in the PICU (van Dijk & Tibboel 2012:1168). To prevent unplanned (or self-extubation), infants and children who need prolonged mechanical ventilator support usually receive more analgesics and sedatives than those in general wards. The level of sedation should be regularly assessed and documented using a sedation assessment scale; in fact, it should be done whenever possible to assess whether the sedation given to the paediatric patients is ‘insufficient’, ‘adequate’ or whether the patient is ‘over sedated’ (Playfor et al. 2008:88 ;Nievas, Spentzas & Bogue 2013:4).

4.4.2.3 Strategy 3: Weaning from sedation

According to the participants, weaning from sedation in the PICU where this study was done posed a challenge. The participants said there needed to be consensus among all the relevant healthcare professionals regarding the criteria for weaning the mechanically ventilated paediatric patient from sedation prior to extubation.

Supportive quotes:

- *“we [nurses] should agree on how to wean the sedation prior to extubation of the [paediatric] patient...”*
- *“I [nurse] wean the sedation as I see fit and according to the condition of the patient, as we [nurses] do not agree on the process of weaning patients from sedation...”*
- *“ I [nurse] think the challenge is because we [nurses] do not have a guideline to guide when and how to wean the sedation...”*

Discussion: Weaning is defined as “the time when the patient’s spontaneous breathing alone can provide effective gaseous exchange while positive pressure support is withdrawn” (Newth et al. 2009:2). Over sedation may depress central respiratory drive whereas under sedation can leave the paediatric patient restless; this restlessness can lead to unplanned extubation (Newth et al. 2009:2). The

complications of over sedation include depressed cardiorespiratory function, a decrease in gastrointestinal mortality and an increased risk of ventilator-associated pneumonia (VAP). This leads to withdrawal and prolonged duration of mechanical ventilation which increases length of stay in the PICU (Hofso & Coyer 2007:250).

The infusion of analgesic and sedative agents are frequently used in the PICU to provide a continuous level of comfort to critically ill paediatric patients (Deeter et al. 2011:683). The selection and method of the administration of sedative and analgesics depend on the paediatricians. Analgesics should be administered by continuous infusion or on a planned intermittent basis with additional boluses being given as required for breakthrough pain or prior to painful procedures (van Dijk & Tibboel 2012:1168). Every intubated paediatric patient in the PICU is required to have a written prescription by the paediatrician with regard to his or her sedation level. The prescribed medications should allow the bedside nurse to achieve the goal of optimal sedation to prevent unplanned extubation.

Utilising a standardised weaning protocol results in faster weaning of adults and children; it reduces the mechanical ventilator time and results in better patient outcomes (Newth et al. 2009:9).

Step 2: Collaborative refinement and implementation of learning events

Following the FGI the researcher (who is a paediatric nurse working in the PICU where the study was conducted) rescheduled a meeting with the healthcare professionals working in PICU. Feedback on the research findings of Phase 1 (pre-test) and Phase 2 (preliminary development of learning events/the learning event?) was given to all the healthcare professionals. The feedback sessions were scheduled to take place between 12 June and 16 June 2014 during which the researcher gave feedback to her colleagues in the PICU about the findings of Phase 1 (pre-test) and Phase 2 (preliminary development of learning events. The researcher highlighted the importance of healthcare professionals (paediatricians and nurses) to collaboratively refine the plan developed during Step 1 as the incidence of unplanned extubation of the mechanically ventilated paediatric patient in the PICU was a very high 37% in relation to the international statistics of 3% to 14%

(Rachman & Mink 2012:614). These feedback sessions were repeated during the day and night shifts until all the staff members working in the PICU had received the information.

The healthcare professionals in the PICU agreed the two main challenges (*inappropriate physical restraints* and *ineffective sedation*) on which consensus was reached during Step 1 had to be addressed during the learning events (view Table 4.2). During these feedback sessions consensus was reached to form workgroups to refine and implement the learning events. The researcher asked for volunteers to participate as members of the workgroups. Two workgroups were formed. Each of these two groups was responsible for refining and implementing a learning event.

- 4.4.3 Workgroup 1: *Appropriate physical restraints*
- 4.4.4 Workgroup 2: *Effective sedation*

Each workgroup's activities are discussed in Section 4.4.3 to 4.4.4.

4.4.3 Workgroup 1: *Appropriate physical restraints*

Nine (9) nurses volunteered and willingly signed the informed consent forms for participation in the workgroup that was formed to refine and implement the learning event which focused on addressing inappropriate physical restraints (view Annexure E1). A session was scheduled for 19 June 2014 in the PICU. The nurses who participated in the workgroup comprised of one (1) registered critical care nurse, three (3) paediatric registered nurses, four (4) registered nurses (paediatric experience), and one (1) enrolled nurse who had experience in the PICU. The workgroup collaborated for approximately 45 minutes. Using the strategies compiled during the FGI as a guide, the participants agreed on and refined the strategies that were to be implemented as part of the learning event to address inappropriate physical restraints as summarised in Table 4.3.

Table 4.3: Appropriate physical restraints: summary of strategies implemented

Strategies	Implementation
Provide in-service training sessions regarding the use of physical restraints.	<ul style="list-style-type: none"> Healthcare professionals attended a minimum of one in-service training session. Ten (10) minute information sessions were facilitated during the day and night shifts. This process continued until all staff members attended an information session.
Comprehensive information and informed consent.	<ul style="list-style-type: none"> Nurses focused on explaining the importance of physical restraints to parents/caregivers. All parents/caregivers signed an informed consent document for the application of physical restraints. (<i>View Annexure E2</i>).
Restraining method for endotracheal tube.	<ul style="list-style-type: none"> The restraining method used to secure the endotracheal tube was demonstrated. All endotracheal tubes were secured with Elastoplast and Friars Balsam®.
Restraining method for ventilator circuit.	<ul style="list-style-type: none"> The restraining method used to secure the ventilator circuit was demonstrated. All ventilator circuits were secured with Elastoplast and a safety pin
Develop a poster to demonstrate the different methods of restraining the paediatric patient.	<ul style="list-style-type: none"> Two nurses developed the poster. (<i>View Annexure E1</i>). Posters were distributed and placed in different areas in the PICU where they were visible to all staff. The intent was to raise awareness and reinforce to nurses that restraining methods were in place and had to be followed.
Assistance during procedures to prevent unplanned extubation.	<ul style="list-style-type: none"> During handover all the healthcare professionals were reminded to assist each other during procedures (for example, with a bed bath or endotracheal suctioning) to prevent accidental extubation.
Specific rest periods from physical restraints.	<ul style="list-style-type: none"> Physical restraints used to secure the limbs were removed for 10 minutes every two (2) hours.
Accurate recording of perfusions and skin integrity of restrained limbs.	<ul style="list-style-type: none"> Perfusion and skin integrity were recorded every two (2) hours during the 10-minute rest periods from physical restraints.

The workgroup facilitated the implementation of the strategies summarised in Table 4.3 over a period of two months before the post-test was conducted.

4.4.4 Workgroup 2: Effective sedation

Six (6) nurses volunteered and willingly signed informed consent forms to participate in the workgroup that addressed ineffective sedation (view Annexure D). The session

was conducted on 24 June 2014. The nurses who volunteered included one (1) registered critical care nurse, three (3) paediatric registered nurses, and two (2) registered nurses (paediatric experience). The planning session lasted for approximately 40 minutes. Using the strategies compiled during the FGI (view Section 4.4) as a guide, the participants agreed on and refined the strategies that were implemented as part of the learning event to address ineffective sedation. During the session the participants reflected they needed to collaborate with the consultant (head of the PICU) to develop a standardised sedation protocol as well as criteria for the weaning from sedation prior to extubation of the mechanically ventilated paediatric patient.

The researcher made an appointment with the consultant and shared the findings of Phase 1 (pre-test) and Phase 2 (preliminary development of learning events). The consultant indicated her willingness and support for the research project and agreed to collaborate with the nurses in the PICU to develop a standardised sedation protocol. Thereafter, the researcher and the workgroup had several meetings and work sessions with the consultant to develop and refine a standardised sedation protocol (view Annexure E 3).

Once the standardised sedation protocol was finalised, the researcher and registered paediatric nurses facilitated information sessions during both the day and night shifts for a period of one week. All healthcare professionals attended a minimum of one information session to discuss and assimilate the standardised sedation protocol for implementation in the PICU.

Table 4.4: Effective sedation: summary of strategies implemented

Strategies	Implementation
Develop a standardised sedation protocol.	<ul style="list-style-type: none"> Collaborate with the consultant to develop a standardised sedation protocol.
Provision of comprehensive information regarding the standardised sedation protocol.	<ul style="list-style-type: none"> All of the healthcare professionals attended at least one (1) in-service training session. Ten (10) minute information sessions were facilitated during both the day and night shifts. During handover, all healthcare professionals were reminded to adhere to the sedation protocol.

Strategies	Implementation
Develop a poster of the standardised sedation protocol.	<ul style="list-style-type: none"> • The consultant and members of the work group developed the poster. (<i>View Annexure E3</i>). • Posters were distributed and strategically placed by each PICU bed where they were visible to guide healthcare professionals on effective sedation practices.
Use the standardised sedation protocol when sedating a mechanically ventilated paediatric patient.	<ul style="list-style-type: none"> • All day and night shift healthcare professionals in the PICU implemented the sedation protocol.

The workgroup facilitated the implementation of the strategies summarised in Table 4.4 over a period of two months before conducting the post-test.

4.5 PHASE 3: POST-TEST

In Phase 3 the researcher collected data in the same manner as discussed in Phase 1 (view Section 4.2). The researcher retrospectively conducted the clinical audits. She used the flow charts of all mechanically ventilated paediatric patients managed in the PICU over a period of two months following the implementation of the collaboratively planned strategies to address the incidences of unplanned extubation in the PICU (Phase 2). The data were collected from 1 August 2014 to the 30 September 2014. During this timeframe, a total number of 38 mechanically ventilated paediatric patients were managed; six (15.7%) incidents of unplanned extubation occurred.

The research findings will be discussed as it relates to the items identified in the clinical audit tool (view Annexure B).

4.5.1 Section A: Demographic information

A total of six (N=6) incidences of unplanned extubation occurred. Two (n=2; 33.3%) paediatric patients were male and four (n=4; 66.6%) were female. The patients' ages ranged from six months to three-years-and-nine-months-old with an average age of 19 months.

4.5.2 Section B: Incidences

The majority (n=5; 83.3%) unplanned extubation occurred during the day shift (07:00 to 19:00) and four (n=1; 16.6%) occurred during the night shift (19:00 to 07:00). The nurse-to-patient ratio during the incidences of unplanned extubation were 1:1 in four (n=4; 66.6%) of the incidents with a 1:2 ratio in two (n=3; 33.3%) incidences. All six (N=6; 100%) paediatric patients required reintubation following the incident.

4.5.3 Section C: Chemical restraints

Of the six (N=6) incidences of unplanned extubation, two (n=2; 33.3%) paediatric patients received Morphine Sulphate®, one (n=1; 16.6%) received Midazolam®, and one (n=1; 16.6%) paediatric patient received Tilitidine® (Valoron). The other two paediatric patients were not sedated.

4.5.4 Section D: Physical restraints

During the six (N=6) incidences of unplanned extubation, four (n=4; 66.6%) paediatric patients were restrained and two (n=2; 33.3%) were not restrained. All the patients' (N=6; 100%) tracheal tubes were secured with plaster and TB Co and their ventilator circuits were secured.

Unplanned extubation mainly occurred during the following procedures:

- tracheal suctioning (n=1; 16.6%);
- bed bath (n=3; 50%);
- while changing the patient's position (n=1; 16.6%);
- physiotherapy (n=1; 16.6%)

No unplanned extubation occurred during the following two procedures:

- when securing the tracheal tube; and
- during X-rays.

Also, none of the paediatric patients self-extubated.

4.5.5 Section E: Complications

Two (n=2; 33.3%) paediatric patients presented with more than one complication following unplanned extubation. Stridor presented as a complication following unplanned extubation in three (n=3; 50%) of the paediatric patients. Two (n=2; 33.3%) of the paediatric patients presented with pulmonary arrest and three (n=3; 50%) presented with cardiac arrest. None of the paediatric patients died following the incident of unplanned extubation.

4.6 SUMMARY

Chapter 4 provided the research findings of Phases 1 to 3 and included an in-depth discussion of relevant literature to support the findings. A pre-test (Phase 1) was conducted relating to the incidences of unplanned extubation of the mechanically ventilated paediatric patient. During Phase 2 the healthcare professionals collaboratively planned and implemented learning events to address the factors contributing to unplanned extubation. Following a two-month implementation period, a post-test (Phase 3) was conducted to determine the impact of the learning events on the incidence of unplanned extubation. In Chapter 5 conclusions are drawn from the study findings and recommendations are made.

5 CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

5.1 INTRODUCTION

Chapter 4 was dedicated to an in-depth discussion of the study findings in relation to relevant literature. In this Chapter, the conclusions related to the aim and objectives of the study will be discussed, recommendations will be made and the limitations of the study will be indicated.

5.2 AIM AND OBJECTIVES

The overall aim of this study was to plan and implement a learning event to decrease the incidence of unplanned extubation in the PICU.

The objectives were to:

- assess the incidence the incidence of unplanned extubation in a selected PICU (pre-test)
- develop and implement a co-constructed learning event in the selected PICU, and to
- re-assess the incidence of unplanned extubation in the selected PICU following the implementation of the learning event (post-test).

The objectives will be used to guide the conclusions drawn and recommendations made.

5.3 CONCLUSIONS

The conclusion of the three objectives will be discussed in Sections 5.3.1 to 5.3.3.

5.3.1 Objective 1: Pre-test

The first objective was to assess the incidence of unplanned extubation in a selected PICU. A clinical audit was conducted using the flow charts of all mechanically ventilated patients over a period of two months stretching from 1 January 2014 to 28 February 2014. A total of 37 mechanically ventilated paediatric patients' flow charts were audited.

Worldwide between 3% and 15% incidences of unplanned extubation of mechanically ventilated paediatric patients are reported. In the selected PICU in Gauteng, South Africa the incidence of unplanned extubation was 14 (N=14; 37%), of which 10 (71.4%) patients required reintubation. The majority of incidents (71.4%) occurred during the day shift (07:00 to 19:00) and only eight (57.1%) paediatric patients were restrained. The incidence of unplanned extubation mainly occurred during the following procedures: tracheal suctioning (14.2%), bed bath (14.2%), changing of position (14.2%) and physiotherapy (21.4%). Complications included stridor (64.2%), pulmonary arrest (28.5%), and cardiac arrest (14.2%). Two (14.2%) paediatric patients died following the incidence of unplanned extubation. Some patients presented with more than one complication.

5.3.2 Objective 2: Development and implementation of learning events

The development and implementation of the learning events was conducted in two steps. During Step 1 a focus group interview (FGI) was conducted with 23 healthcare professionals (22 nurses and a physiotherapist) to develop preliminary learning events to address the incidence of unplanned extubation of mechanically ventilated paediatric patients. The participants indicated and reached consensus that the learning events should focus only on two of the contributing factors identified during Phase 1, namely inappropriate physical restraints and ineffective sedation. The participants agreed on preliminary strategies (view Table 4.2) to address the identified contributing factors to decrease the incidence of unplanned extubation. The participants further concluded they believed the preliminary strategies should be refined and implemented on ward level (PICU) in collaboration with the healthcare professionals involved in the management of mechanically ventilated paediatric patients.

During Step 2 the researcher gave feedback regarding the study findings of Phase 1 (pre-test) and Phase 2 (preliminary development of learning events) to all the healthcare professionals. Collaboration among all healthcare professionals concerned with managing of the paediatric patients in the PICU was emphasised as core to the successful implementation of learning events to address the incidents of unplanned extubation in the PICU. Following the feedback sessions, the healthcare professionals agreed that two workgroups should be formed to refine and implement the learning events. Nurses volunteered to participate in the two workgroups. One workgroup focused on refining and implementing the learning event to address inappropriate physical restraints while the second workgroup focused on ineffective sedation.

The strategies that were planned as part of the learning events were implemented over a period of two months (view Tables 4.3 and 4.4.). Following the implementation of the learning events (done from 1 June 2014 to 31 July 2014), the post-test was conducted.

5.3.3 Phase 3: Post-test

The post-test was conducted over a period of two months – from 1 August 2014 to 30 September 2014. Thirty-eight (38) mechanically ventilated paediatric patients' files were audited showing a total of six (15.7%) incidences of unplanned extubation occurred. The majority incidences of unplanned extubation (38.3%) occurred during the day shift (07:00 to 19:00) and all the patients required reintubation (n=6). A total of 66.6% (n=4) paediatric patients were restrained while 33.3% (n=2) were not restrained.

A positive outcome was that all six (100%) patients' ventilator circuits were secured. Activities during which extubation of the paediatric patients occurred included bed bath (50%), position changing (16.6%), and physiotherapy (16.6%). The complications the paediatric patients presented with following the unplanned extubation incidents were stridor (50%), pulmonary arrest (33.3%), and cardiac arrest (50%). Some patients presented with more than one complication.

5.4 RECOMMENDATIONS

Based on the findings the following recommendations were made.

⇒ Practice

- Assess current practices regarding unplanned extubation of the mechanically ventilated paediatric patient.
- Compare assessment findings to international findings to determine standard of care delivered.
- Based on the assessment findings, identify the contributing factors to plan and implement learning events to decrease incidences of unplanned extubation.
- Secure endotracheal tubes with Elastoplast® and Friars Balsam.
- Secure the ventilator circuit with Elastoplast® and a safety pin.
- Ensure that the restraining method used for the paediatric patient is age-specific.
- Remove restraints for 10 minutes every two hours to ensure rest periods.
- Evaluate perfusion and skin integrity of the limbs involved in physical restraining and document the findings.
- Utilise a standardised sedation protocol for all mechanically ventilated paediatric patients.
- Re-think preventative strategies to ensure that healthcare professionals are aware of risk of unplanned extubation during the execution of procedures such as endotracheal suctioning, bed bath, and securing of the endotracheal tube.
- Make sure healthcare professionals are vigilant during procedures to prevent unplanned extubation.

⇒ Management

- Provide opportunities for nurses to take responsibility and be accountable for the monitoring and evaluation of practice.

- Develop nurses' leadership skills to empower them to lead workgroups to address challenges in practice.
- Raise healthcare professionals' awareness of current practices.
- Collaborate with healthcare professionals to assess practice, identify contributing factors to the incidence of unplanned extubation, plan and implement learning events and then re-assess practice.
- Include healthcare professionals in quality control initiatives.
- Promote support for multidisciplinary collaboration to augment ownership and success of quality control initiatives.
- Monitor and evaluate unplanned extubation of the mechanically ventilated paediatric patient continuously as patients may suffer complications which can lead to death.

⇒ Education

- Address the knowledge and skill related to restraining methods which include appropriate restraining methods of the endotracheal tube, ventilator circuit, and the paediatric patient through in-service training programmes.
- Schedule continuous professional development sessions to ensure that all healthcare professionals are informed about the standardised sedation protocol used in the PICU.

5.5 LIMITATIONS

The research was limited to the PICU of one tertiary hospital in one province, namely Gauteng. The involvement of PICUs in the private sector may provide a broader understanding of the incidence of unplanned extubation of the mechanically ventilated paediatric patient in practice.

This study did not address the knowledge of nurses in relation to physical restraining methods used in the paediatric settings. Assessing the incidence of unplanned extubation remains challenging, specifically when considering the complications that paediatric patients can present with following unplanned extubation (including death).

5.6 FUTURE RESEARCH

Topics for future research studies include:

- conducting a similar study in a different context – the private sector;
- investigating the impact of unplanned extubation on the length of hospital stay and costs involved;
- exploring the sustainability of the implementation of the learning events.

5.7 CONCLUSION

The study objectives were met and the overall aim of the study was achieved. The research findings substantiate that there was a positive outcome for the mechanically ventilated paediatric patient as the incidence of unplanned extubation decreased from 37% to 15% following the implementation of the learning events. The study promoted collaboration among healthcare professionals through the process of planning and implementing learning events to address the contributing factors associated with unplanned extubation. Assessment of practice, collaborative planning, developing and implementing learning events/a learning event, and a re-assessment of practice are vital to ensure optimal patient outcomes.

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