UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Development of a clinical pathway for non-invasive ventilation in a private hospital in Gauteng

By

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A dissertation submitted in the fulfillment of the requirements for the degree of

Magister Curationis (Clinical)

In the

Department of Nursing Science
School of Healthcare Sciences
Faculty of Health Sciences
University of Pretoria

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2011

Declaration

Student number: 23293595

I declare that **DEVELOPMENT OF A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION IN A PROVATE HOSPITAL IN GAUTENG** 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.

---------- ----------

Liezl Balfour **Date**

"If the power to do hard work is not talent, it is the best substitute for it."

James Abram Garfield

This dissertation is dedicated to my loving family.

Acknowledgements

"Let never day nor night unhallowed pass, but still remember what the Lord hath done."

William Shakespear
1564 – 1616

Thank you to our heavenly Father for the strength and ability to perform this monumental task. Praise unto the Lord.

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- **Alexa Barnby** for the editing of the final document. Thank you for the support and assistance during the final stage of the study.

Abstract

Despite the advantages of using NIV, healthcare professionals are not in agreement about precisely when to commence NIV (Elliott, Confalonieri & Nava 2002:1159; Lightowler, Wedzicha, Elliott & Ram 2003: [4]; Garpestad & Hill 2006:147), which adds to the underutilisation of NIV.

The aim of this study was to collaboratively develop a clinical pathway for NIV. Two main objectives were identified, namely (i) to identify the components of a clinical pathway for NIV, and (ii) to develop a clinical pathway for NIV that can be implemented in the CCU.

The research design utilised for this study was qualitative, contextual, explorative and descriptive in nature. The study consisted of three phases, namely Phase 1: Components of the clinical pathway, Phase 2: Literature control, and Phase 3: Development of the clinical pathway.

The objectives of the study were met, and a clinical pathway for NIV was developed.

Key words

Mechanical ventilation, noninvasive ventilation, clinical pathway, care pathway, respiratory failure, respiratory distress, artificial airway, acute respiratory failure, qualitative research

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Invitation to participate

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B.2

Participant information CD

B.3

Participation leaflet and Informed consent : Phase 1

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B.4

Participation leaflet and Informed consent : Phase 3

Participation leaflet and informed consent

Developing a draft clinical pathway for non-invasive ventilation

Dear Colleague

You are invited to participate in the development of a clinical pathway for the use of non-invasive ventilation (NIV) in the critical care unit (CCU) that will take place over a period of twelve months within the CCU. This information leaflet contains information that will help you understand your role in the study. If there is any need for further clarification, please feel free to contact the researcher at any time.

TITLE OF STUDY

Developing a draft clinical pathway for noninvasive ventilation (NIV).

1) The purpose and objectives of the study

You are requested to take part in **Phase 1** of a research study. Your participation will be as a member of the multidisciplinary team in CCU.

Invasive mechanical ventilation is associated with complications such as trauma to the airway, hospital and ventilator acquired infections, prolonged hospitalisation and increased costs. Non-invasive ventilation is a relatively new mode of ventilation that has gained more support during the past decade, mainly due to the fact that these complications can be reduced or avoided. Although evidence exists to support the use of NIV, there are no explicit guidelines for the initiation and use of NIV.

The aim of this study is to collaboratively develop a draft clinical pathway for the use of NIV that can be implemented in the CCU.

In order to achieve this aim, the objectives and specific objectives of the research, are listed below:

In order to achieve this aim, the objectives of the research will be to:

- collaboratively develop a draft clinical pathway for NIV
- validate the clinical pathway through literature control

2) Explanation of procedures to be followed

Your participation as a member of the multi-disciplinary team in the CCU will be to collaborate with other members of the multi-disciplinary team to construct a draft clinical pathway for NIV that can be implemented in CCU. Brainstorming sessions will be scheduled and the date and time made available in advance on the notice board in the tea room. An outline of the procedure is depicted below:

In order to facilitate the brainstorming sessions, these steps will be followed:

Step 1: Introduction to the study and the aims and objectives of the study. Informed consent will be signed by the participants.

Step 2: Reach concensus on the ground rules for this brainstorming session. Kreitner and Kinicki (2007:391) suggest the following ground rules:

- Defer judgement: Do not criticise during the initial stage of idea generation/phrases such as “it won’t work”, or “management will never agree” or “everybody will never follow the same clinical pathway” should not be used
- Build on the ideas of others: Encourage out-of-the-box thinking/ the wider or more outrageous the ideas the better
- Go for quantity over quality: participants should try to generate and write down as many new ideas as possible/focusing on quantity encourages people to think beyond their favourite ideas
- Be visual: the use of different coloured pens provided to write on the flipcharts
- Stay focused on the topic: the facilitator will keep the discussion on target and walk between the groups to ensure the group members stay focused
- One conversation at a time: the ground rule applies that no one should interrupt another person, no dismissing of someone else’s ideas, no disrespect and no rudeness
- The group members will be granted the opportunity to add to the ground rules

Step 3: Individual participants will be asked to silently generate ideas or alternatives to the open-ended questions posted on the PowerPoint presentation. This step is included , as silent idea generation is preferable over the practice of having group members randomly shout out their ideas , because it leads to a greater number of unique ideas (Kreitner & Kinick 2007:390).

Step 4: Individuals share their ideas/alternatives with the sub-group members
Step 5: Each sub-group develops a clinical pathway on the flip chart. Stationery will be provided for this step.
Step 6: One participant of each sub-group will discuss the clinical pathway
Step 7: Input from all sub-groups will be utilised in a "think tank" to develop a preliminary clinical pathway and consensus reached regarding the content thereof
Step 8: Participants will be thanked for their input and refreshments will be served.

3) Risk and discomfort involved

As a participating practice leader, you will experience no discomfort. There is also no risk involved in this study. However, your input into this project will require a lot of time and effort.

4) Benefits of the study

Research has confirmed the benefits of NIV, including decreased lung injuries, reduced infection rates, decreased length of stay, decreased cost, and enhanced patient comfort. The collaborative efforts of the members of the multi-disciplinary team might enhance communication amongst team members, as well as show a positive impact on patient outcomes.

5) Voluntary participation in and withdrawal from the study

Participation occurs on a voluntary basis, and you can withdraw from the project without stating any reason should you no longer wish to take part.

6) Ethical approval

The Faculty of Health Sciences' Research Ethics Committee at the University of Pretoria, has granted written approval for this study.

7) Additional information

If you have any questions about your participation in this research project, you should contact the researcher, Liezl Balfour –

Work telephone: (011) 812 4063
Mobile phone: 083 703 2755
Email address: liezlbalfour@mweb.co.za

8) Confidentiality

Your input into this research will be kept confidential. Results will be published and presented in such a manner that you as a participant will remain anonymous.

9) Consent to participate in this study

Your participation in this research is subject to reading and accepting the above information and signing the informed consent document below. A copy of the signed consent document will be given to you.

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of me. Its content and meaning have been explained to me. I have been given the opportunity to ask questions and received satisfactory answers. I hereby volunteer to take part in this research.

_____ _____

Participant's signature **Date**

_____ _____

Person obtaining informed consent **Date**

_____ _____

Witness **Date**

_____ _____

Liezl Balfour **Date**

Researcher

Participation leaflet and informed consent

Developing a final clinical pathway for noninvasive ventilation

Dear Colleague

You are invited to participate in developing a final clinical pathway for the use of non-invasive ventilation (NIV) in the critical care unit (CCU) that will take place over a period of twelve months within the CCU. This information leaflet contains information that will help you understand your role in the study. If there is any need for further clarification, please feel free to contact the researcher at any time.

TITLE OF STUDY

Developing a clinical pathway for noninvasive ventilation (NIV).

1) The purpose and objectives of the study

You are requested to take part in **Phase 3** of a research study. Your participation will be as a member of the multidisciplinary team. During this phase of the data collection, the focus will be on reaching consensus and finalising the clinical pathway for implementation in the CCU.

Invasive mechanical ventilation is associated with complications such as trauma to the airway, hospital and ventilator acquired infections, prolonged hospitalisation and increased costs. Noninvasive ventilation is a relatively new mode of ventilation that has gained more support during the past decade, mainly due to the fact that these complications can be reduced or avoided. Although evidence exists to support the use of NIV, there are no explicit guidelines for the initiation and use of NIV.

The aim of this study is to collaboratively develop a final clinical pathway for the use of NIV that can be implemented in the CCU. In order to achieve this, the aim of these sessions will be to :

- Reach consensus on the components/content of the final clinical pathway for NIV to be implemented in CCU.

2) Explanation of procedures to be followed

You are invited to participate in a collaborative effort to evaluate the content of the c\draft clinical pathway that has been developed for NIV. The following is expected of you:

- **Step 1:** Please read through the document and make comments in writing on the clinical pathway. Should you not be in agreement aboput the information, please attach the relevant evidence, for example the research article, to the document.
- **Step 2:** Use the evaluation instrument provided to evaluate the content of the clinical pathway.
- **Step 3:** Return the clinical pathway (comments included) and the evaluation instrument to the researcher before or on **20 September 2010.**

3) Risk and discomfort involved

As a participating practice leader, you will experience no discomfort. There is also no risk involved in this study. However, your input into this project will require a lot of time and effort.

4) Benefits of the study

Research has confirmed the benefits of NIV, including decreased lung injuries, reduced infection rates, decreased length of stay, decreased cost, and enhanced patient comfort. The collaborative efforts of the members of the multi-disciplinary team might enhance communication amongst team members, as well as show a positive impact on patient outcomes.

5) Voluntary participation in and withdrawal from the study

Participation occurs on a voluntary basis, and you can withdraw from the project without stating any reason should you no longer wish to take part.

6) Ethical approval

The Faculty of Health Sciences' Research Ethics Committee at the University of Pretoria, has granted written approval for this study.

7) Additional information

If you have any questions about your participation in this research project, you should contact the researcher, Liezl Balfour –

Work telephone: (011) 812 4063

Mobile phone: 083 703 2755

Email address: liezlbalfour@mweb.co.za

8) Confidentiality

Your input into this research will be kept confidential. Results will be published and presented in such a manner that you as a participant will remain anonymous.

9) Consent to participate in this study

Your participation in this research is subject to reading and accepting the above information and signing the informed consent document below. A copy of the signed consent document will be given to you.

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of me. Its content and meaning have been explained to me. I have been given the opportunity to ask questions and received satisfactory answers. I hereby volunteer to take part in this research.

_____ _____

Participant's signature **Date**

_____ _____

Person obtaining informed consent **Date**

_____ _____

Witness **Date**

_____

Liezl Balfour

Researcher

EVALUATION INSTRUMENT

Please indicate with an 'x' the answer that best describes your impressions of the clinical pathway for NIV according to the set criteria:

EVALUATION INSTRUMENT

	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly				
Simplicity				
Consistency				
Comprehensiveness				
Importance for nursing practice development				
Applicable to CCU				
Other (please specifiy)				

Additional comments:

_____

_____

_____

_____

_____

Thank you for your time and effort. It is much appreciated.

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Dear Colleague

Date: 25/06/2010 **Time: 08:00 for 08:30**

Venue: University of Pretoria, Faculty of Health Science, Department of Nursing Science, 8th floor

Noninvasive ventilation (NIV) is being used more and more in the critical care setting, yet there is very little information available to assist the us with the clinical application of NIV to potentially improve patient outcomes.

Your participation in this research initiative can make a valuable contribution to the development of a clinical pathway specifically for NIV.

Contact person: Liezl Balfour
R.S.V.P before or on 2010/06/01 at 076 618 4527 via sms (please incl. your name)

TO PHASE 1 OF
"DEVELOPING A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION" IN COLLABORATION WITH THE UNIVERSITY OF PRETORIA

The CD included with this invitation contains your registration documents, participant information leaflet and informed consent form.

Liezl Balfour
Principle Investigator
083 703 2755
076 618 4527
For more information

WE'RE DELIGHTED TO INVITE YOU...

Created just for you by Liezl

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List of abbreviations

ARF	Acute respiratory failure
CCU	Critical Care Unit
COPD	Chronic obstructive pulmonary disease
NIV	Non-invasive ventilation
SANC	South African Nursing Council

1 ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Over the past ten years, noninvasive ventilation (NIV) has gained popularity as a new alternative to invasive ventilation for many reasons, including reduced rates of ventilator associated pneumonia, avoidance of endotracheal intubation, shortened length of stay in hospital, and increased patient comfort (Plant, Owen, Parrott & Elliott 2003:[1]; Hill, Brennan, Garpestad & Nava:2007:[1]; Endorf & Dries 2010:217).

Traditionally, invasive ventilation, which requires the insertion of an endotracheal tube into the patient's airway, is considered as the "gold standard" for the management of patients presenting with acute respiratory failure (ARF). Today, complications such as ventilator-induced lung injuries, barotrauma, ventilator associated pnuemonia and injuries to the airway are associated with invasive ventilation methods (Hill *et al.* 2007:[1];Parsons & Wiener-Kronish 2007:52; Endorf & Dries 2010:217). As a result, invasive ventilation has become less favoured over the past decade (Gunduz, Unlugenc, Ozalevli, Inanoglu & Akman 2005:325; Garpestad & Hill 2006:147).

In a society where healthcare systems are under pressure to be cost-effective, healthcare professionals have been prompted to find creative solutions to problems of increasing costs, whilst still delivering high quality patient care (Renholm, Leino-Kilpi & Suominen 2002:196). Brochard, Mancebo and Elliott (2002:712) state that NIV has become a new and important mode of ventilation for the management of patients presenting with ARF, as it reduces the need for

invasive ventilation. The use of NIV has been reported to reduce complications concerning invasive ventilation, thereby saving on hospital costs (Metha & Hill 2001:542; Maggiore, Richard, Abroug, Diehl, Antonelli, Sauder, Mancebo, Ferrer, Lellouche, Lecourt, Beduneau & Brochard 2010:145).

Many studies have been conducted to establish the effectiveness and safety of NIV, but there remains a lack of concurrence among healthcare professionals about the appropriate implementation of NIV (Antonelli, Pennisi & Conti 2003:65s; Antonelli, Pennisi & Montini 2005:98; Garpestad & Hill 2006:147). Despite the advantages of using NIV, healthcare professionals are not in agreement about precisely when to commence NIV (Elliott, Confalonieri & Nava 2002:1159; Lightowler, Wedzicha, Elliott & Ram 2003: [4]; Garpestad & Hill 2006:147).

The development of a clinical pathway for the use of NIV might result in the possibility of concurrence among healthcare professionals, and provide a possible solution to NIV appropriate implementation (Renholm *et al.* 2002:196). The development of a clinical pathway for NIV may enhance the consensus between multidisciplinary team members regarding the initiation of NIV and should improve collaboration between multidisciplinary team members. This is consistent with the views of Dufault and Willey-Lessne (1999:20) and Lombardo, Bridgeman, De Michelis and Nunez (2008:45).

The aim of this study is therefore to develop a clinical pathway for NIV that can be applied in the critical care unit (CCU).

1.2 BACKGROUND AND RATIONALE

The history of mechanical ventilation in critical care extends over more than four and a half centuries (Gedeon 2006:[5]). Traditional methods of invasive ventilation require the insertion of an endotracheal tube into the patient's airway.

However, this can lead to complications, which increase the cost of treatment (Dasta, McLaughlin, Mody & Piech 2005:1217).

Noninvasive ventilation is used for the management of respiratory failure in critically ill patients, and has been reported to have the same efficacy and bring about the same physiological improvement as invasive ventilation, whilst reducing the complications associated with endotracheal intubation (Winck, Azevedo, Costa-Pereira, Antonelli, & Wyatt 2006: [1]). The most recognised benefit for the use of NIV is the reduction in the complications associated with endotracheal intubation. The avoidance of endotracheal intubation reduces the risk of complications such as ventilator acquired pneumonia and lung injuries that could lead to extended hospital stay (Winck *et al*. 2006: [2]; Antonelli & Bello 2008:136). The avoidance of these complications could therefore be cost-effective, as stated by Baudouin, Blumenthal, Cooper, Davidson, Davison, Elliott, *et al.* (2002:193) and Elliott *et al.* (2002:1164). The use of NIV at an early stage has reduced the need for endotracheal intubation (Agarwal, Gupta, Aggarwal & Gupta 2008:742). In addition, the use of NIV does not necessitate sedation of the patient, and therefore allows for normal activities such as eating, drinking and communication whilst being ventilated (Baudouin *et al.* 2002: 199). This enhances the patient's comfort and psychological wellbeing (Metha & Hill 2001:542).

It is the opinion of Elliott *et al*. (2002:1163) that noninvasive ventilation is underutilised. The underutilisation of NIV can be attributed to several factors. First and foremost, NIV is a relatively new mode of mechanical ventilation and there is a degree of uncertainty about its use, as well as the perceived added workload associated with the initiation of NIV (Elliott *et al.* 2002:1163). Secondly, although there are many studies stating the benefits of NIV (Brochard *et al.* 2002:719; Elliott *et al.* 2002:1164; Antonelli *et al.* 2005:98), there are no published guidelines regarding the effective use of NIV in critical care units (Winck *et al*. 2006:[16]; Curtis, Cook, Sinuff, White, Hill, Keenan, *et al.* 2007:[1]).

The development of a clinical pathway for NIV could guide the multidisciplinary team members regarding the initiation of NIV as well as the management of patients receiving NIV. This in turn would be beneficial to patients, owing to the reduced risks involved in this mode of mechanical ventilation. In addition, a clinical pathway may enhance the collaboration of healthcare professionals in improving the quality of care delivered (Lombardo *et al.* 2008:52).

1.3 PROBLEM STATEMENT

Winck *et al.* (2006:[16]) mention the fact that there are no published guidelines available for the effective use of NIV. The lack of consensus among the members of multidisciplinary teams regarding the effective use of NIV adds to the fact that NIV is currently underutilised in the CCU. The available literature mentions many benefits with regard to NIV, which are wasted owing to its underutilisation, as these benefits do not reach the patients for whom they are intended.

The development of a clinical pathway for NIV might present a possible solution to this problem, thereby enhancing the possibility that members of multidisciplinary teams will reach consensus on the use of NIV, and improving patient outcomes (Lombardo *et al.* 2008:52).

1.4 RESEARCH QUESTION

Based on the problem statement, the research question is:

Which components should be included in a clinical pathway for NIV?

1.5 AIM AND OBJECTIVES

The overall aim of the study is to develop a clinical pathway for NIV that can be utilised in a specific CCU in Gauteng. In order to achieve this aim the following objectives were identified:

- to explore the components of a clinical pathway for NIV
- to develop a clinical pathway for NIV that can be implemented in a CCU

1.6 RESEARCHER'S FRAME OF REFERENCE

The researcher's frame of reference for this study is described in terms of the relevant setting for which the clinical pathway was developed, the paradigm or belief system utilised, the conceptual framework on which the study was based and key concepts used.

1.6.1 Setting

Polit and Beck (2008:56) define the research setting as the area where the study will take place, for example the naturalistic setting, which is consistent with qualitative enquiry. The naturalistic setting in this study refers to the CCU of a private hospital in Gauteng.

This hospital is located in an area surrounded by an industrial community. It has a total of 205 beds, of which 14 are dedicated CCU beds for the admission of general medical CCU adult patients. A further six beds are dedicated to surgical CCU adult patients, including those undergoing general surgery, cardiothoracic surgery, trauma and maxilla-facial surgery.

The CCU has had 100% bed occupancy during the past three months (June to August 2009), with an average of 40% of the patients admitted requiring

mechanical ventilation. Mainly critically ill patients are admitted to the CCU, for example patients presenting with respiratory and cardiac-related illnesses.

A unit manager is in charge of the CCU. Fifteen professional nurses, who work both the day and night shifts, work in the unit on a permanent basis. In addition, there are seven enrolled nurses and five enrolled nursing auxiliaries permanently employed in the CCU for both day and night shift. Any staff shortages are addressed by making use of agency staff on a daily basis. Additional multidisciplinary team members involved in the CCU, specifically with regard to mechanical ventilation, are two physicians, one cardiothoracic surgeon and two physiotherapists. The dietary needs of the critically ill patients are addressed by the dietician who consults each patient daily.

The radiography department is responsible for performing daily portable chest x-rays on all patients in the CCU, as well as additional radiology-related tests, for example Doppler studies, computerised tomography (CT) scans and magnetic resonance image scanning (MRI). The nuclear medicine department is responsible for performing specialised nuclear testing on patients, for example V/Q scans.

1.6.2 Paradigm

Kuhn (1996:23) states that a paradigm refers to an accepted model or pattern; however, in the practice of science, the concept refers to belief systems. A paradigm is also described by Polit, Beck and Hungler (2001:11) and Polit and Beck (2008:13) as a "… world view, a general perspective on the complexities of the real world".

The paradigm that will be used in this research is constructivism. Constructivism is derived from the assumption that learning takes place when a person is able to attach meaning to experiences in the real world, and that learning is an active process aimed at deriving understanding from interactions with the environment

(Gravett 2005:219). In other words, it is a process of understanding the relationships between new information and a person's existing knowledge.

"Constructing" thus implies referring to an individual process and it is regarded as a personal responsibility (Gravett 2005:21). Taking ownership of the new information is a vital step in the process of understanding.

1.6.3 Assumptions

Polit and Beck (2008:748) define assumptions as "[a] principle that is accepted as being true based on logic or reason, without proof". The paradigms of human inquiry are categorised according to the ways they respond to the four basic philosophical questions (Polit *et al*. 2001:13; Polit & Beck 2008:13).

Table 1.1: Summary of the assumptions

Assumption	Application
Ontological: What is the nature of reality?	- Reality is multiple and subjective. - Reality is mentally constructed by individuals.
Epistemological: How is the inquirer related to those being studied?	- The researcher interacts with those being researched. - Knowledge creation is a collaborative, inductive process.
Methodological: How is evidence best obtained?	- Context bound and contextualised. - The methodology is a flexible and emergent design with qualitative data analysis. -The aim of the research is to improve patient outcomes for patients receiving NIV in CCU.

Source: Adopted from Polit and Beck (2008:14)

In nursing research, the constructivist paradigm is also referred to as the naturalistic paradigm, which is based on specific assumptions as delineated in Table 1.1.

The constructivist paradigm is referred to as the naturalistic paradigm, which is based on specific assumptions. Table 1.1 provides the assumptions on which this study is based as well as the application of these assumptions to the study. It is derived from the constructivist paradigm.

1.6.4 Conceptual framework

Conceptual frameworks are the building blocks of research, and attempt to provide a broad description of the phenomenon of interest. Conceptual frameworks can provide the starting point for generating research hypotheses (Mateo & Kirchhoff 1991:131; Polit & Beck 2008:141). According to Walsh (1998:2) conceptual frameworks represent what really happens in nursing because they are derived from observation, and are therefore practice based.

The conceptual framework applicable to this study is the nursing process. The nursing process was originally developed by Ida Jean Orlando in the late 1950s, as a practical means of guiding nurse practitioners in their practice (Quan 2007: [1]). Nurse practitioners engage the nursing process everyday to improve the outcomes of their patients and to assist medical doctors in treating them. The nursing process is a systematic, problem-solving process consisting of five major steps (Suddarth 1991:5; Quan 2007: [1]).

The steps of the nursing process include the following:

- assessment and nursing diagnosis
- planning
- implementation
- evaluation

Figure 1.1 is a schematic representation of how the research process aligns with the nursing process in this study.

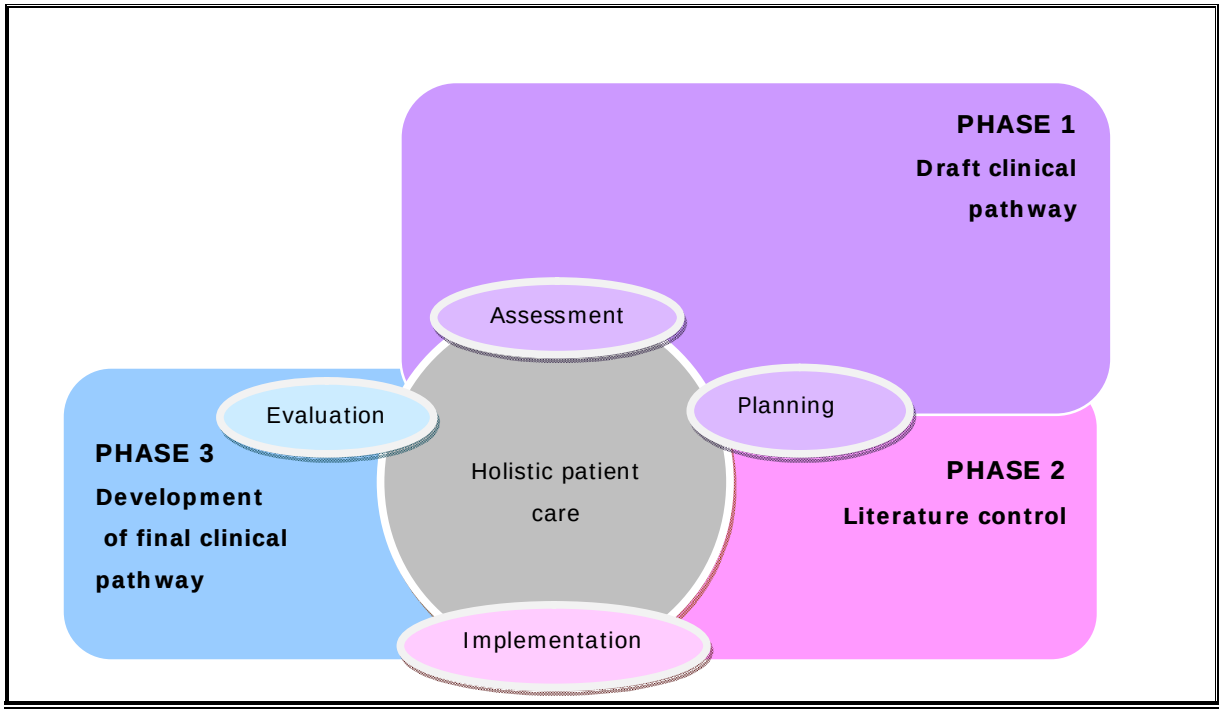

Figure 1.1: The nursing process *(adopted from Suddarth 1991:5)*

1.6.4.1 Assessment

This step is used to gather data on the health status of the patient and to identify actual and potential problems. Analysis of the data is also included in this step and assessment data are recorded in the progress notes (Suddarth 1991:4; Quan 2007: [1]).

Assessment will form part of Phase 1 of this study, during which the components to be included in the clinical pathway will be identified.

1.6.4.2 Planning

Planning involves setting goals to improve patient outcomes. These goals are derived from the assessment data, and form a "map" of the expected outcome for the patient. However, these goals have to be patient centred. In addition, this step includes planning for the interventions necessary to achieve the desired patient outcomes. The planned intervention and the expected outcome are recorded in the patient file (Suddarth 1991:4; Quan 2007: [1]).

For the purposes of this study, planning will form part of Phase 1 of this study.

1.6.4.3 Implementation

It is during this step that the nursing care plan is put into action. The planned interventions are executed according to the identified priorities and the patient's response to the intervention is carefully recorded along with any additional information relevant to the patient's health status (Suddarth 1991:5; Quan 2007: [1]).

For the purposes of this study, implementation will form part of Phase 2. During Phase 2 of the study, the researcher will conduct a literature control to verify the data collected during phase 1. Following Phase 2 of the study, implementation will also form part of phase 3, during which the final clinical pathway will be developed.

1.6.4.4 Evaluation

Evaluation includes collecting objective data to assess the degree to which the expected outcomes have been met. Evaluation is a continuous process, which allows for alterations in the nursing care plan and the patient goals in order to achieve the expected outcomes. Recording the evaluation data takes place throughout, and serves as written proof of the patient's health status, the interventions made, patient progress and expected outcomes (Suddarth 1991:5; Quan 2007: [1]).

For the purposes of this study, evaluation will form part of phase 3. This phase will also include the implementation of the collected and verified data and the development of the final clinical pathway. This final clinical pathway will be evaluated by the participants (see Annexure B4).

1.6.4.5 Recording

Both Suddarth (1991:5) and Quan (2007) state the importance of accurate and concise record keeping at each step of the nursing process. Accurate record

keeping promotes the communication between members of the multidisciplinary team, and accounts for all healthcare interventions, which is essential for monitoring patient progress (Owen 2005:48).

The importance of legal record keeping cannot be over emphasised (Owen 2005:48), and for this reason the researcher has decided to include recording as a separate step in the nursing process.

1.6.4.6 Holistic patient care

Suddarth (1991:4) describes the nursing process as "cyclic" and maintains that all the steps of the process are therefore interrelated, interdependent and recurring. This allows for the constant reassessment of the patient and the patient's responses to healthcare interventions, in an effort to meet the patient's needs (Suddarth 1991:5; Quan 2007: [1]).

1.6.5 Clarification of key concepts

In the context of this research and for simplicity and consistency throughout this dissertation, the following key concepts are defined:

1.6.5.1 Acute respiratory failure (ARF)

The literature defines acute respiratory failure (ARF) as a severe deterioration in gas exchange, which often requires mechanical ventilatory assistance with endotracheal intubation (Antonelli *et al.* 2005:98). Acute respiratory failure is characterised by a reduction in respiratory drive, decreased muscle strength, decreased chest wall elasticity, reduced lung capacity for gas exchange, increased airway resistance and an increased metabolic oxygen demand, which causes impaired gas exchange and leads to hypoxemia (Urden, Stacey & Lough 2002:551).

Acute respiratory failure can be defined as a clinical condition where the pulmonary system can no longer maintain adequate gas exchange. The survival

rate of patients presenting with ARF is estimated at 55% (Urden *et al.* 2002:551). Acute respiratory failure usually occurs secondarily to another condition which has led to an alteration in the normal functioning of the pulmonary system.

This definition has been adopted for this study, but includes ***adult*** patients who show ***no alteration in the level of consciousness***, and who are ***able to maintain their airway***.

1.6.5.2 Clinical pathway

Feuth and Claes (2008:56) define a clinical pathway as: "… the optimal care processes, sequencing and timing of interventions by healthcare professionals for a particular diagnosis or procedure.", and emphasise that it may be used as a strategy for improving care in the clinical setting.

The European Pathway Association (2005:[1]) defines a clinical pathway as: "… a methodology for the mutual decision making and organization of care for a well-defined group of patients during a well-defined period".

For the purposes of this study the term "clinical pathway" will refer to the sequence of events, based on the nursing process, to be followed for adult patients presenting with ARF who require NIV.

1.6.5.3 Multidisciplinary team members

Patient care should be viewed as a holistic activity. The collaboration of the members of the multidisciplinary team ensures high quality patient care delivery (Pearson, Goulart-Fisher & Lee 1995:943; Panella, Marchisio & Di Stanislao 2003:509). The multidisciplinary team members included in this study consist of nurse practitioners, physiotherapists and physicians.

⇨ Nurse practitioners

The Nursing Act (no. 33 of 2005) defines a nurse practitioner in section 30 (1) as "… a person who is qualified and competent to independently practice

comprehensive nursing in a manner and to the level prescribed and who is capable of assuming responsibility and accountability for such practice [sic]".

In addition, the regulations pertaining to nursing practice in South Africa are Regulation 2598 – Scope of Practice of the Registered nurse, and Regulation 387 – Acts and Omissions. These provide nurse practitioners with guidelines for the practice of their profession.

⇨ **Physiotherapist**

A physiotherapist can be defined as someone able to treat diseases, injuries or weakness in the joints or muscles with exercises, massage, and the use of light and heat (*The Oxford Advanced Learner's Dictionary* 2005:1092). In the CCU, the physiotherapist is responsible for the treatment of the patients according to the underlying pathology. Patients receive chest physiotherapy which includes percussion, vibration and deep-breathing exercises to assist with clearing the airways of secretions. Physiotherapists are required to register with the Health Professions Council of South Africa (HPCSA).

For the purpose of this study a physiotherapist refers to the physiotherapist working in the CCU, who is registered with the HPCSA and who treats patients on a daily basis, as prescribed by the physician.

⇨ **Physician**

A physician is defined as a medical doctor who is a specialist in general medicine, but not surgery (*The Oxford Advanced Learner's Dictionary* 2005:1092). Physicians practising in South Africa need to be registered with the Health Professions Council of South Africa (HPCSA), and to conform to the set criteria.

There are two physicians working full time in the CCU. Other specialist medical doctors, for example, pulmonologists, surgeons and neurosurgeons, work on a consultation basis in the CCU.

1.6.5.4 Mechanical ventilation

Mechanical is defined as "… performed by means of some apparatus …" or "… automatic ..." (*Stedman's Medical Dictionary* 2000:1074). Ventilation is defined as "… movement of gas into and out of the lungs …" (*Stedman's Medical Dictionary* 2000:1952).

The primary purpose of mechanical ventilation is to deliver a specific and reliable concentration of oxygen to an ill or injured patient who is hypoxic or in danger of becoming hypoxic (Proehl 2009:161). It maintains alveolar ventilation or the exchange of gas between the lungs and the ambient air by causing flow in and out of the lungs by changing the airway pressure (Proehl 2009:160).

Mechanical ventilators have the capacity to operate in different ventilatory modes, such as invasive and noninvasive ventilation.

1.6.5.5 Invasive ventilation

Invasive ventilation is a mode of ventilation where oxygen is delivered to the patient via an endotracheal tube placed in the upper airway. The objective is to support the cardiopulmonary gas exchange, increase lung volume and reduce the work of breathing (Urden *et al.* 2002:599). This definition will be accepted for the purposes of this study.

1.6.5.6 Noninvasive ventilation (NIV)

Noninvasive ventilation (NIV) is a new mode of mechanical ventilation whereby ventilatory support is given to the patient without the necessity for an invasive endotracheal tube (Urden *et al.* 2002:551).

It is defined by Antonelli *et al.* (2005:98), Penuelas, Frutos-Vivar and Esteban (2007:1211) and Sharma (2006: [1]) as the delivery of assisted breaths without the use of an artificial airway to patients presenting with ARF.

For the purposes of this study NIV will refer to the delivery of oxygen and assisted breathing without the use of an endotracheal tube to adults presenting with ARF.

1.7 THE METHOD

A research method refers to the orderly, disciplined fashion in which data will be collected for this study (Polit & Beck 2008:17). The emphasis is on exploring the phenomenon in the natural setting where it occurs. The research method delineates the way the study will be structured and how the data will be gathered and analysed systematically (Polit & Beck 2008:765). The following section provides a brief overview of the research method used in the study, which includes the research design and methodology.

1.7.1 Research design

The research design can be described as the overall plan for addressing the research question (Polit & Beck 2008:765). Hence the choice of research design needs to be the design most appropriate to the research question (Brink 2006:118). This study will make use of a design that is qualitative, contextual, explorative and descriptive in nature.

A comprehensive discussion of the design aspects will be provided in chapter 3.

1.7.2 Research methodology

Research methodology can be defined as the techniques employed by researchers to structure the study, as well as to collect and analyse the data (Polit & Beck 2008:15). Chapter 3 includes comprehensive information on the research methodology, including the population, sampling, data collection, and data analysis.

Table 1.2: Summary of the research phases

Phase 1: Components of the clinical pathway			
Objective: Explore the components of a clinical pathway for NIV			
Step 1: Components			
Population and sampling	**Data collection**	**Data analysis**	**Trustworthiness**
Population Members of multi-disciplinary team currently working in CCU **Sampling** Non-probability sampling: • Purposive sampling • Snowball sampling **Sample size** 15 participants	**Naïve sketch** Group discussion and **Brainstorming session**: • Field notes • Audio taped	**Content analysis** • Content categorised • Tabulated • Reorganised	Strategies to enhance **trustworthiness** used from Lincoln and Guba's (1985) framework: • Credibility • Dependability • Confirmability • Transferability
Step 2: Feedback and consensus			
Each small group will provide feedback on the components of a clinical pathway for NIV. Consensus between all the participants will be reached pertaining to the final components to be included in the clinical pathway for NIV.			
Phase 2: Literature control			
Based on the data collected during Phase 1, a comprehensive literature control will be conducted.			

<table>
<tr><th colspan="4">Phase 3: Develop the clinical pathway</th></tr>
<tr><td colspan="4">Objective: Develop a clinical pathway for NIV that can be implemented in a CCU.</td></tr>
<tr><th colspan="4">Step 1: Draft a clinical pathway</th></tr>
<tr><td colspan="4">Once the data have been verified by the literature control during Phase 2, the researcher will develop a draft clinical pathway.</td></tr>
<tr><th colspan="4">Step 2: Feedback and consensus</th></tr>
<tr><th>Population and sampling</th><th>Data collection</th><th>Data analysis</th><th>Trustworthiness</th></tr>
<tr><td>Population
Members of multidisciplinary team currently working in CCU

Sampling
Non-probability sampling:
• Purposive sampling
• Snowball sampling

Sample size
20 participants</td><td>Written comments

Completion of the evaluation instrument</td><td>Content analysis</td><td>Strategies to enhance trustworthiness from Lincoln and Guba's (1985) framework:
• Credibility
• Dependability
• Confirmability
• Transferability</td></tr>
<tr><th colspan="4">Step 3: Final clinical pathway</th></tr>
</table>

This study will consist of three phases, namely Phase 1: Development of a draft clinical pathway for NIV; Phase 2: Literature control; and Phase 3: Development of a final clinical pathway for NIV. Each phase will be briefly illustrated in tables 1.2 and 1.3, and a comprehensive discussion will be provided in chapter 3 of the study.

The phases are as follows:

o Phase 1: Components of the clinical pathway
- Step 1: Identify components
- Step 2: Feedback and consensus

- Phase 2: Literature control
- Phase 3: Develop the clinical pathway
  - Step 1: Draft clinical pathway
  - Step 2: Written feedback and consensus
  - Step 3 : Final clinical pathway

A summary of the three phases of the study is depicted in Table 1.2 above. Aspects of trustworthiness will be discussed in detail in chapter 3.

1.8 ETHICAL CONSIDERATIONS

Research ethics involves protecting the rights of the respondents and the institutions in which the research was done, and maintaining scientific integrity (Babbie & Mouton 2001:530; Burns & Grove 2005:181).

According to Struwig and Stead (2001:66), ethics refers to a set of moral principles that is suggested by an individual or group and is widely accepted, and that offers rules and behavioural expectations about the most correct conduct towards experimental subjects and respondents, sponsors and other researchers. A number of key phrases describe the system of ethical protections that have been created to try to protect the rights of research respondents.

The principle of voluntary participation requires that people should not be coerced into participating in research. Closely related to the notion of voluntary participation is the requirement of informed consent (Struwig & Stead 2001:67–68). Essentially, this means that prospective research respondents must be fully informed about the procedures and risks involved in the research and must give their consent to participate (see Annexure B1 to B4).

Ethical standards require that researchers should not put respondents in situations where they might be at risk of harm as a result of their participation. Harm can be classified as physical, emotional, social and psychological (Burns & Grove 2005:190).

In addition, the privacy of research respondents should be ensured during the research process. Burns and Grove (2005:186) state that the participants have the right to determine the time, extent and general circumstances for sharing their personal information.

According to Burns and Grove (2005:177), research ethics are based on the principles as described by the ten provisions of the Nuremberg Code. This Code provided a basis for the Declaration of Helsinki in 1964, which was subsequently adopted by many countries engaged in health care research.

In the following table the principles of the Nuremberg Code according to Burns and Grove (2005:177) are given and the application applicable to this study described briefly. A comprehensive discussion of the ethical issues pertaining to this study is provided in chapter 3.

Table 1.3: Summary of the application of the principles of the Nuremberg Code

Principles of the Nuremberg Code	Application to this study
Voluntary consent is essential	Completion of the informed consent form will constitute voluntary consent for participation in the study.
Study should yield fruitful results for the good of society	The results of the study will be used to construct a clinical pathway for NIV that will be implemented in the CCU. The researcher regards this as an essential step in ensuring quality care for the patient receiving NIV in CCU.
Previous results should justify the study	The researcher will conduct an in-depth literature control on the topic to ensure trustworthiness.

Principles of the Nuremberg Code	Application to this study
Study should avoid all unnecessary physical and mental suffering and injury	There are no perceived risks of harm to respondents in this study, as there are no planned interventions or potentially harmful activities included.
No study should be conducted if it is believed death or disabling injury will occur	Participants will receive an information leaflet explaining the aims and objectives of this study. There are no perceived risks that could lead to disability or death.
The degree of risk should never exceed the potential benefits of the study	In this study there will be no risks for respondents involved in the data collection process.
The study should only be conducted by qualified persons	The researcher is a qualified registered nurse and has successfully completed a research methodology module. In addition, the supervisors are both recognised researchers.
Respondents should be free to withdraw at any time	It will be explicitly explained to respondents that they may withhold consent or withdraw from the study at any time during the data collection without risk of penalty or prejudice.
The persons undertaking the study must be prepared to stop the study if a continuation is likely to cause harm	Approval for this study will provided by the Research and Ethics Committee of the University of Pretoria.

Source: Adopted from Burns and Grove (2005:177)

The Nuremberg Code, as described by Burns and Grove (2005:177), reflects the three notions most appropriate to this study and which the researcher aims to uphold. These include the principles of autonomy, beneficence and justice.

The principle of autonomy refers to the recognition that people, including the research participants, have the right to decide on a particular course of action and to follow it (Burns & Grove 2005:181). In this study, the focus is to collaboratively construct a clinical pathway for NIV, which might potentially improve patient outcomes. The scope and benefits of the study will be explained to all the respondents by means of an information leaflet.

The respondents will be assured of anonymity and confidentiality as described by Brink (2006:34). Anonymity will be maintained by not recording the respondents'

names or other identifying data on any documents, and the data collected will be kept in the researcher's possession in a safe place to ensure confidentiality.

The principle of beneficence refers to the requirement that the researcher should maximise benefit to respondents whilst minimising harm (Brink 2006:32; Polit & Beck 2008:147). There are no perceived risks of harm to the respondents as there are no interventions planned for this study.

The principle of justice is described as an essential requirement that resources or activities be fairly distributed among people. In this study, all individuals will have an equal chance of participating in the study without excluding them on the basis of race, language, colour, gender, sexual orientation and age (Burns & Grove 2005:189;Brink 2006:33).

1.9 SIGNIFICANCE

NIV is a new mode of ventilation with many benefits (Brochard *et al.* 2002:719); unfortunately NIV is not yet widely accepted owing to a lack of consensus amongst multidisciplinary team members about the use of NIV (Mechanical ventilation – past, present and future 2004:430). Consequently, patients have not reaped the benefits of these advances in NIV, which could potentially alter their entire hospitalisation experience.

There are currently no published guidelines for the initiation of NIV, and thus, no published clinical pathway for the use of NIV. This study will aim to identify the components that should be included in a clinical pathway for NIV, and validate the findings through a literature control, after which a final clinical pathway will be developed for NIV, which could be implemented in the CCU. The development of a clinical pathway for NIV might present a solution for this problem, as suggested by Kwan (2007:191).

1.10 LIMITATIONS

The limitations of the research refer to restrictions that may influence the generalisability of the findings (Burns & Grove 1993:46; Polit & Beck 2008:73), and factors such as sampling, design and data collection may influence the generalisability of the findings (Burns & Grove 1993:46).

1.10.1 Sampling

The sampling technique selected for this study is purposive sampling, which is a non-probability sampling technique. Purposive sampling involves the purposeful selection of participants by the researcher. Maximum variation sampling involves the selection of participants with a wide variety of views on the topic of interest (Polit & Beck 2008:355).

Purposive sampling may be a limitation of the research owing to the subjective nature thereof and there is no objective measure for assessing the typicality of the selected subjects (Polit & Beck 2008:343).

1.10.2 Setting

The setting for this study will be the CCU of a private sector hospital in Gauteng. Methodological limitations apply to single-setting studies (Burns & Grove 1993:46), which has implications for the generalisability of the findings.

1.11 LAYOUT

The research dissertation comprises of five chapters as delineated in Figure 1.1.

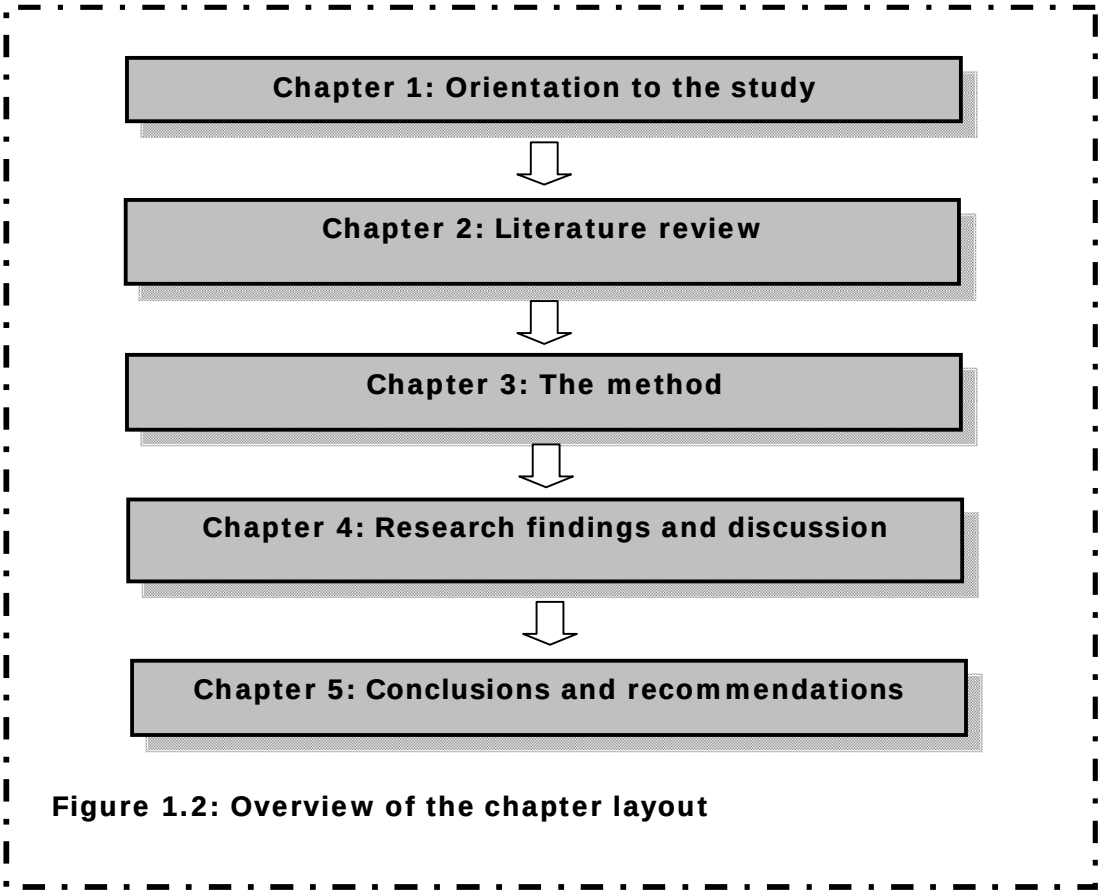

Figure 1.2: Overview of the chapter layout

1.12 CONCLUSION

In light of the available evidence to support the use of NIV, the effective use of this treatment modality needs to be explored. Although the evidence supports the use of NIV, there is little knowledge available on when the best time is for the implementation of NIV.

The development of a clinical pathway for commencing NIV for patients with ARF could address patient outcomes by potentially reducing the cost of the treatment, reducing the length of stay in the CCU, enhancing collaboration within the multidisciplinary team, and increased patient comfort and satisfaction. Developing a clinical pathway might potentially enhance the learning experience of the healthcare professionals involved in caring for the patient by providing a standard of care. The clinical pathway could also be used for auditing purposes in

order to identify variances in care, and facilitate further research. This study can therefore make a significant contribution to practice development through the development and implementation of a clinical pathway for NIV in the CCU.

In Chapter 2 the literature review is discussed.

2 LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided an overview of this study. This chapter will provide an in-depth discussion of the anatomy and physiology of normal respiration. Mechanical ventilation is discussed, specifically relating to invasive and noninvasive ventilation. The benefits, indications, contra-indications, complications and predictors of failure and knowledge gaps of these ventilation modes are portrayed. In addition the clinical pathway, including the history, benefits, barriers and examples are discussed.

2.2 ANATOMY AND PHYSIOLOGY OF NORMAL RESIRATION

The anatomy and physiology of normal respiration is discussed in the section that follows in order to clarify the concepts involved in mechanical ventilation.

2.2.1 Airway structures

The process of respiration/breathing is facilitated by the use of muscles and other macroscopic structures. These structures are briefly discussed in the following section.

2.2.1.1 Muscles of inhalation

The major muscle responsible for inhalation is the diaphragm, which has a dome-shaped fibromuscular structure. Anteriorly, the diaphragm is attached to the ribs and sternum, and posteriorly to the vertebrae. The diaphragm serves to separate the thoracic and abdominal cavity (Kaplow & Hardin 2007:271; Marieb 2007:346).

During inhalation, the diaphragm contracts and flattens, thereby pushing down on the abdominal structures and pushing the abdomen outward. The ribcage is also lifted and expanded (Urden *et al.* 2002:498; Kaplow & Hardin 2007:272; Marieb 2007:853). The external intercostal muscles play a significant role in elevating the ribs and expanding the ribcage in order to facilitate inhalation (Urden *et al.* 2002:499;Marieb 2007:347).

2.2.1.2 Muscles of exhalation

Normal exhalation in healthy lungs requires very little energy and is regarded as a passive event (Urden *et al.* 2002:499; Kaplow & Hardin 2007:274). When the diaphragm relaxes and moves up toward the lungs, exhalation occurs. The internal intercostal muscles assist with the process of exhalation by causing an inward movement of the ribs. The intrinsic elastic recoil of the lungs also assists in the process of exhalation by reducing the size of the lungs.

2.2.1.3 Conducting airways

The conducting airways consist of the following structures:

- upper airway
- trachea
- bronchial tree

The main purposes of the conducting airways include warming and humidifying the inhaled air, protecting the airways from the presence of foreign bodies in areas of gas exchange, and acting as a pathway for the entrance and exit of air from the lungs (Urden *et al.*2002:500;Kaplow & Hardin 2007:275; Marieb 2007:838).

2.2.1.4 Respiratory airways

The respiratory airways are responsible for gas exchange, and include the bronchioles and alveoli. The bronchioles form the transition area in the lungs, and also form part of the conducting airway and the respiratory airway.

The alveoli are the terminal end points of the airway where gas exchange takes place, and are the primary area of gas exchange in the lungs (Urden *et al.* 2002:503; Marieb 2007:84).

2.2.1.5 Ventilation

Ventilation refers to the movement of air into and out of the lungs (*Stedman's Medical Dictionary* 2000:1952; Urden *et al.* 2002:507; Marieb 2007: 847). The two major components of ventilation include inhalation and exhalation.

Inhalation of air occurs when the atmospheric pressure outside the thorax is higher than the negative pressure inside the lungs. The air is then forced into the airways, thereby facilitating inhalation (Kaplow & Hardin 2007:276; Marieb 2007:855).

Exhalation is mostly a passive event, as described earlier, and refers to the movement of air out of the airways into the atmosphere. The elastic recoil of the lungs compress the alveoli, leading to a rise in the intrapulmonary pressure greater than the atmospheric pressure, which forces air out of the lungs (Kaplow & Hardin 2007:276; Marieb 2007:849).

Mechanical ventilation is an intervention that allows for the movement of air into and out of the airways by altering the pressure within the airways. A discussion of mechanical ventilation follows in the Section 2.3.

2.3 MECHANICAL VENTILATION

Mechanical is defined as *"… performed by means of some apparatus …"* or *"… automatic ..."* (*Stedman's Medical Dictionary* 2000:1074). Ventilation is defined as *"… movement of gas into and out of the lungs …"* (*Stedman's Medical Dictionary* 2000:1952).

The primary purpose of mechanical ventilation is to deliver a specific and reliable concentration of oxygen to an ill or injured patient who is hypoxic or in danger of becoming hypoxic (Suddarth 1991:246; Urden *et al.* 2002:599; Proehl 2009:161). It maintains alveolar ventilation or the exchange of gas between the lungs and the ambient air by causing air flow in and out of the lungs via changing the airway pressure (Proehl 2009:160).

2.3.1 History

Two main types of ventilator have been used for the ventilation of patients presenting with ARF, namely negative pressure ventilators and positive pressure ventilators. The first documented evidence of mechanical ventilation describes a negative pressure ventilator developed by the Scottish physician, John Dalziel, in 1838 (Suddarth 1991:246; Metha & Hill 2001:540; Cawley 2007:250). These devices were manually powered, and their use remained limited until the early 1900s when electricity became readily available. Between the 1930s and the 1950s, the outbreak of polio dramatically increased the demand for mechanically assisted ventilation, which led to the development of the first negative pressure ventilator, also known as the iron lung (Metha & Hill 2001:540; Mechanical ventilation – past present and future 2004:430; Gedeon 2006:[3]).

Figure 2.1: A negative pressure body ventilator (aka an iron lung) used during the polio outbreak

Negative pressure ventilators are applied externally and are used to decrease the atmospheric pressure surrounding the thorax, thereby initiating inspiration (Urden *et al.* 2002:600; Gedeon 2006:[3]). During the 1960s, the use of negative pressure ventilators became less favoured with the discovery of positive pressure ventilation techniques.

Positive pressure ventilation requires the insertion of an artificial airway or endotracheal tube into the patient's upper airway. The first cuffed endotracheal tube was developed by Friedrich Trendellenburg in 1871, as a means to prevent aspiration during surgery (Gedeon 2006:[4]).

Figure 2.2: Examples of endotracheal tubes used in practice today

Nearly a decade later the first clinically useful ventilator was developed by Samuel Meltzer and Charles Elsberg (Mechanical ventilation – past, present and future 2004:430; Gedeon 2006:[4]).

Figure 2.3: Modern-day positive pressure ventilator

With positive pressure ventilation, air is forced into the patient's lungs by means of the mechanical drive of the positive pressure ventilator. These ventilators ventilate the patient by means of a four-phase cycle (Urden *et al.* 2002:600).

The four phases of the ventilatory cycle include

- change from exhalation to inspiration
- inspiration
- change from inspiration to exhalation
- exhalation

In order to perform these actions, the following variables are used:

- ***Volume:*** A predetermined volume of air is delivered to the patient according to the patient's needs. The ventilator will terminate the mechanical breath when the predetermined volume has been delivered.
- ***Pressure:*** The pressure at which the mechanical breath is delivered to the patient is set, and the mechanical breath will be terminated when the desired pressure is achieved.
- ***Flow:*** A flow-triggered breath is a patient-assisted breath initiated when the patient is able to lower the flow within the breathing circuit in order to trigger the ventilator.
- ***Time*:** The time setting controls the time it takes to deliver the mechanical breath to the patient. The ventilator will automatically be triggered to deliver mechanical breaths to the patient at the preset time interval, for example every six seconds.

Mechanical ventilators have the capacity to operate in different ventilatory modes, such as invasive and noninvasive ventilation (Suddarth 1991:247; Urden *et al.* 2002:601; Kaplow & Hardin 2007:308). These modes will be outlined in table 2.1.

Table 2.1: Ventilator modes

Mode of ventilation	Clinical application	Nursing implications
Controlled ventilation (CV) • pressure • volume	Primarily used in apnoeic patients	Used in patients unable to initiate breathing Spontaneously breathing patients must be sedated and/or paralysed
Assist-control (A/C) or continuous mandatory ventilation (CMV) delivers gas at preset tidal volume or pressure in response to the patient's inspiratory efforts and will initiate breath if patient fails to do so within preset time limit	Primary mode of ventilation in spontaneously breathing patients with weak respiratory muscles	Hyperventilation can occur in patients with increased respiratory rates Sedation may be required to limit the number of spontaneous breaths
Synchronous intermittent mandatory ventilation (SIMV) delivers gas at preset tidal volume or pressure and rate while allowing patient to breathe spontaneously; ventilator breaths are synchronised with patient efforts	Primary mode of ventilation in a wide variety of clinical conditions as well as a weaning mode	May increase the work of breathing and promote respiratory muscle fatigue

Mode of ventilation	Clinical application	Nursing implications
Positive end-expiratory pressure (PEEP): positive pressure applied at the end of expiration, used with A/C, CV, and SIMV	PEEP and CPAP are used in patients with hypoxemia refractory to oxygen therapy Increases functional residual capacity	Side effects include decreased cardiac output, volutrauma and increased intracranial pressure
Constant positive airway pressure (CPAP): positive pressure applied during spontaneous breathing	Improves oxygenation by opening collapsed alveoli at end expiration	No ventilator breaths are delivered in PEEP and CPAP mode unless used with A/C, CV and SIMV
Pressure support ventilation (PSV):	Primary mode of ventilation in patients with stable respiratory drive Used with SIMV to support spontaneous breaths	Advantages include increased patient comfort, decreased work of breathing, decreased respiratory muscle fatigue, and promotion of respiratory muscle conditioning

Source: Adapted from Urden et al. (2002:601)

The ventilator modes applicable to NIV are SIMV, PEEP, CPAP and PSV, as outlined in Table 2.1. For the purpose of this study, NIV will refer to all of the applicable modes as listed.

2.3.2 Invasive ventilation

Invasive ventilation is a mode of ventilation where oxygen is delivered to the patient via an endotracheal tube placed in the upper airway. The objective is to support the cardiopulmonary gas exchange, increase lung volume and reduce the

work of breathing (Urden *et al.* 2002:599). The picture below shows the correct placement of an endotracheal tube.

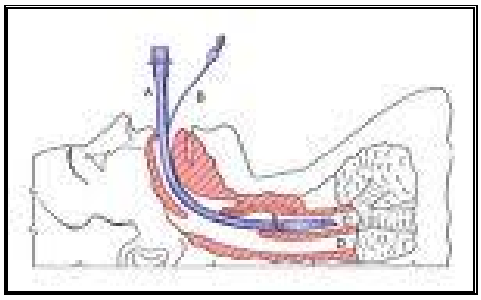

Figure 2.4: Placement of endotracheal tube in patient airway

For many years invasive ventilation was considered the "gold standard" for the management of patients presenting with ARF. However, owing to the complications associated with this mode of ventilation, alternative methods have become more appealing (Gunduz *et al.* 2005:325; Garpestad & Hill 2006:147; Parsons & Wiener-Kronish 2007:52; El-Khatib & Bou-Khalil 2008:[1]).

As mentioned in Section 2.2.1.5, mechanical ventilation occurs by altering the pressures within the airways. The various modes of ventilation are classified according to the treatment goals for the specific patient (dependant on the underlying pathology) and the degree to which the patient is able to participate in the ventilatory pattern (Urden *et al.* 2002:600; Hill *et al* 2007:[2]). Various modes of ventilation are used, and different modes can be used in conjunction with one another.

2.3.3 Noninvasive ventilation

Noninvasive ventilation (NIV) is a new mode of mechanical ventilation whereby ventilatory support is given to the patient without the need to insert an invasive endotracheal tube (Sprague, Graff & Tobias 2000:[1]; Urden *et al.* 2002:551; Hill *et al.* 2007:[1]; Kaplow & Hardin 2007:301). It is defined by Antonelli *et al.* (2005:98), Sharma (2006:[1]) and Penuelas *et al.* (2007:1211) as the delivery of assisted breaths to patients presenting with ARF without the use of an artificial

airway. The past decade has seen a renewed interest in the use of NIV for both acute and chronic respiratory failure (Hill *et al.* 2007:[2]; Robert & Argaud 2007:[1]). Noninvasive ventilation can be described as the delivery of oxygen to the patient from a pressure controlled ventilator.

In NIV, a bi-level positive airway pressure device (BiPAP) or a continuous positive airway pressure (CPAP) device is used and the oxygen is delivered through a face or nasal mask or helmet (Robert & Argaud 2007:[2]; Costa, Navalesi, Spinazzola, Rossi, Cavaliere, Antonelli, Proietti & Conti 2008:1102). The use of the face or nasal mask eliminates the need for endotracheal intubation (Sharma 2006:[2]).

A variety of NIV masks are available today. Figure 2.5 shows examples of the various masks and how they are fitted to the patient. The facemask mostly used in CCU forms a seal over the mouth and nose of the patient as seen on the left image in Figure 2.5.

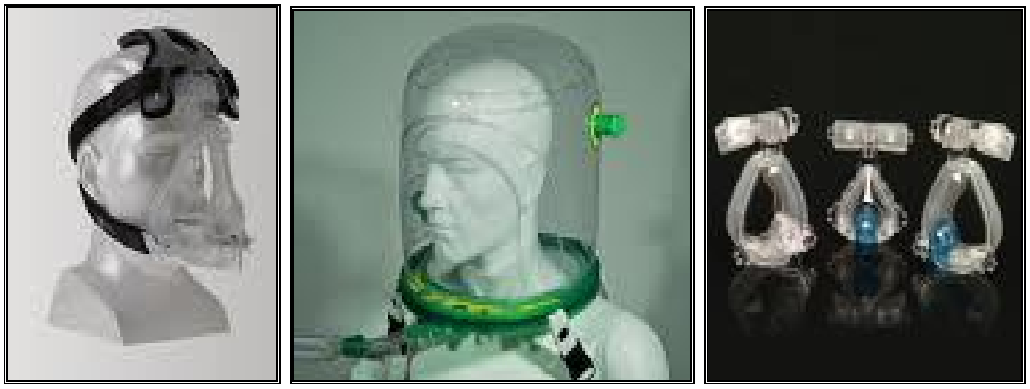

Figure 2.5: Examples of different facemasks used for NIV

The patient receives inspiratory positive airway pressure during inspiration to improve the tidal volume and lung capacity for gas exchange. The patient also receives positive end expiratory pressure (PEEP) to maintain alveolar ventilation and enhance gas exchange. The ventilator settings can be adjusted for the optimal ventilation of the patient (Urden *et al.* 2002:551).

The applications of NIV are not limited to ARF related to chronic obstructive pulmonary disease (COPD), and its application to a variety of critically ill patients is being investigated (Hill *et al.* 2007:[1]). Hill *et al.* (2007:[2]) state that the aetiology of ARF is an important factor influencing the efficacy of NIV. Agarwal *et al.* (2008:738) concur, stating that NIV has revolutionised the treatment of patients presenting with ARF of diverse aetiology.

2.3.3.1 Benefits

Research has confirmed the benefits of NIV, including decreased airway injuries, reduced infection rates, shortened length of stay in the CCU, decreased cost, and enhanced patient comfort (Brochard *et al.* 2002:712*;* Antonelli *et al.* 2003:65s; Antonelli *et al.* 2005:98; Kaplow & Hardin 2007:301).

⇨ ***Decreased airway injuries***

Brochard *et al.* (2002:712) state that the use of NIV in patients with acute exacerbations of COPD reduces the incidence of barotrauma and allows the patient to take deeper breaths without increasing the work of breathing. This reduction in the work of breathing adds to patient comfort and allows for a quicker recovery. Antonelli *et al*. (2003:65s) state that the avoidance of endotracheal intubation also protects the patient's airway from complications such as tracheal stenosis and injuries to the tracheal mucosa, which could predispose the patient to ventilator associated pneumonia and other hospital-acquired infections. Elliott *et al.* (2002: 1160) state that the use of NIV greatly reduces the need for endotracheal intubation at a later stage, which also prevents the complications associated with invasive ventilation methods, such as airway injuries and infections.

⇨ **Reduced infection rates**

Noninvasive ventilation does not necessitate the invasion of the patient's airway with an artificial airway and therefore reduces the risk of infection (Baudouin *et al.* 2002:199; Brochard *et al.* 2002:715; Antonelli *et al.* 2005:98; Endorf & Dries 2010:217). Other complications associated with invasive ventilation include ventilator associated pneumonia and hospital-acquired infections

⇨ **Shortened length of stay**

Several authors have concluded that the use of NIV has the potential to shorten the length of stay of patients in the CCU (Elliott *et al.* 2002:1161; Lightowler *et al.* 2003:[1]; Gunduz *et al.* 2005:325; Kaplow & Hardin 2007:301; Endorf *et al.* 2010:217). This reduction in the length of stay is mainly attributed to the reduced risk of infection because the normal protective mechanisms in the patient's airway are not disturbed by invasive procedures.

Although some studies found that the length of stay in patients receiving NIV did not significantly differ from those receiving invasive ventilation, there is evidence to support the contrary (Trevisan & Vieira 2008:[4]). A systematic review of randomised controlled trials by Lightowler *et al.* (2003:[3]) concluded that the average length of stay was reduced by three days, irrespective of whether the patient received NIV in the CCU or a general medical ward.

Elliott *et al*. (2002:1163) also state that there is evidence to support the fact that the use of NIV can reduce the length of stay in the CCU and even the entire hospital stay when compared to other treatment methods, for example medical treatment or invasive mechanical ventilation. Metha and Hill (2001:558) agree that the hospital stay can be reduced for a selected group of patients when treated with NIV.

In an economic analysis of randomised clinical trials conducted in 2003, the cost of NIV was significantly lower when compared to standard methods of care (Plant *et al.* 2003:[3]). Lightowler *et al.* (2003:[3]) mention that the reduction in the length of stay in CCU has important implications for the cost-effectiveness of NIV, and that most of the complications associated with intubation can be avoided, thereby further reducing the cost of CCU treatment.

⇨ **Decreased costs**

As mentioned by Elliott *et al.* (2002:1161), Gunduz *et al.* (2005:325) and Endorf *et al.* (2010:218), the reduced rate of infections with the use of NIV can shorten the hospital stay of the patient. This equates to a reduction in the total cost of hospital stay which benefits the patient in the end.

⇨ **Enhanced patient comfort**

Metha and Hill (2001:542) state that NIV is a comfortable alternative to endotracheal intubation because the patient does not have to endure the discomfort of regular endotracheal suctioning. The patient managed with NIV is also able to communicate with nurse practitioners and relatives, thereby reducing feelings of isolation and powerlessness (Kaplow & Hardin 2007:301).

The patient is also able to continue normal oral intake of food, fluids and medication, thereby reducing the incidence of adverse gastro-intestinal effects (Sprague *et al.* 2000:[8]; Metha & Hill 2001:542). This is consistent with the views of Endorf and Dries (2010:217).

2.3.3.2 Indications

NIV might not be suitable for all patients. One of the critical indicators for the use of NIV is that the patient should be awake and able to maintain the airway. Some absolute and relative indications have been identified (Brochard *et al.* 2002:718).

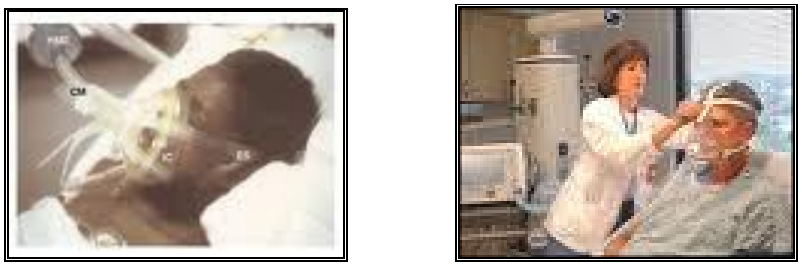

Figure 2.6: Patients receiving NIV

Patients who are considered less suitable candidates for endotracheal intubation, for example the elderly and those with advanced disease or "do not resuscitate" directives, benefit from the use of NIV by rapidly improving gas exchange (Brochard *et al.* 2002:718). Hill *et al.* (2007:[5]) state that the use of NIV in this particular group of patients should only be attempted if the treatment goals are clear, for example to alleviate dyspnoea, or delay death in order to settle personal affairs. There should be frequent reassessment of these patients to

establish whether the goals of treatment are being met, or whether the treatment should be terminated.

In addition, Fraticelli *et al.* (2009:939) state that NIV is effective in reducing the work of breathing, improving gas exchange and relieving dyspnoea in patients suffering from ARF, acute exacerbations of COPD and cardiogenic pulmonary oedema. This is consistent with the view of Hill *et al.* (2007:[3]). It was also found that endotracheal intubation may increase patient discomfort, which could result in injury to surrounding tissue thereby predisposing the patient to hospital-acquired pneumonia (Elliott *et al.* 2002:1161; Gunduz *et al.* 2005:325; Kaplow & Hardin 2007:301; Endorf *et al.*2010:218).

Noninvasive ventilation provides a more flexible approach to endotracheal intubation as ventilation takes place via the facemask (Penuelas *et al.* 2007:1221). Another important benefit of NIV is that the patient does not need to endure the discomfort of the regular endotracheal suctioning associated with endotracheal intubation, which also increases the incidence of hospital-acquired pneumonia (Metha & Hill 2001:542).

The inability to communicate with relatives and members of the multidisciplinary team as a result of invasive ventilation also leads to feelings of anxiety, isolation and powerlessness (Metha & Hill 2001:558; Antonelli *et al.* 2003:65s).

2.3.3.3 Contra-indications

The uses of NIV are continually expanding. Brochard *et al.* (2002:719) state that there are no absolute contra-indications for the use of NIV, but that the failure of NIV to significantly improve patient outcomes can be ascribed to several factors, for example level of consciousness, hypoxic status, haemodynamic status, facial trauma and end-stage disease and the presence of several co-morbidities.

Hill *et al.* (2007:[6]) outline the contra-indications for NIV as respiratory arrest, medically unstable, unable to protect the airway, excessive secretions, agitation,

uncooperativeness, recent upper gastro-intestinal or airway surgery, and the inability to fit the face mask.

Endorf *et al.* (2010:217) state that a key indicator of the success of NIV is the patient's level of consciousness. The patient should be able to breathe spontaneously and be able to maintain and protect the airway. Other contra-indications for the use of NIV include haemodynamic instability, compromised cough and secretion clearance, uncooperative patients and excessive facial hair which influences mask fit. Endorf *et al.* (2010:218) indicate that morbid obesity is a relative contra-indication for NIV owing to the increased pressure from body weight and the weight of the abdominal viscera when the patient is in a supine position.

Table 2.2 outlines the absolute and relative contra-indications as described by Brochard *et al.* (2002:719), Hill *et al.* (2007:[6]) and Endorf *et al.* (2010:217).

Table 2.2: Absolute and relative contra-indications for NIV

Parameter	Absolute	Relative
Impaired level of consciousness	√	
Agitation		√
Excessive secretions	√	
Uncontrolled vomiting	√	
Inability to protect airway	√	
Pregnancy		√
Haemodynamic instability		√
Severe progressive respiratory failure		√
Apnoea	√	

Parameter	Absolute	Relative
Cardiac arrest	√	
Recent surgery: upper airway or gastro-intestinal tract	√	
Facial trauma	√	

Source: Adopted from Brochard et al. (2002:719), Hill et al. (2007:[6]) and Endorf et al. (2010:217)

From Table 2.2 above it is clear that some contra-indications for the use of NIV exist and should be considered.

2.3.3.4 Complications

Noninvasive ventilation is a fairly new concept and factors that may influence the efficacy of NIV are present. The failure of NIV can be attributed to several factors, including air leaks, nasal congestion, nasal dryness, aerophagia, and poor patient tolerance of the face mask or interface (Kaplow & Hardin 2007:303; Trevisan & Vieira 2008:[3]; Fraticelli *et al.* 2009:939). The failure of NIV might lead to endotracheal intubation of the patient.

The most recognised complication of NIV found in the literature is the failure of NIV related to poor tolerance of the face mask. Poor patient tolerance of the face mask might reduce the efficacy of NIV and influence the cooperation of the patient (Fraticelli *et al.*2009:939; Costa *et al.*2008:1107). Other complications associated with face masks include local skin irritation and skin breakdown in the areas where the mask touches the patient's skin, particularly the nose (Costa *et al.* 2008:1107).

2.3.3.5 Predictors of failure

Hill *et al.* (2007:[6]) and Endorf *et al.* (2010:220) agree that for NIV to be successful, the predictors of failure should be taken into account. The likelihood of failure is greater when three or more of the predictors are present. These

predictors of NIV failure are assessed at the baseline and again after two hours of NIV.

Factors that might cause NIV to fail include air leaks related to poor mask fit, asynchrony, copious secretions, a Glasgow Coma Score (GCS) of less than eleven (11), lack of tolerance, lack of compliance, respiratory rate exceeding 35 breaths per minute, shock, severe hypoxemia, metabolic acidosis, pneumonia, acute lung injury (ALI), and blood pH < 7,25 (Hill *et al.* 2007:[7]; Endorf *et al.* 2010:220).

2.3.3.6 Knowledge gaps

There is evidence to support the use of NIV in patients with ARF (Brochard *et al.* 2002:719; Winck *et al*. 2006:[1–2]). Studies have been conducted to investigate the safety and efficacy of NIV, but no consensus has been reached on the specific criteria for initiating NIV (Brochard *et al.* 2002:719; Winck *et al.* 2006:[16]). As suggested by Winck *et al*. (2006: [16]), the lack of consensus on using NIV in CCU should be considered for further research in order to establish the best practice methods.

2.4 CLINICAL PATHWAY

An in-depth discussion of clinical pathways follows in Sections 2.4.1 to 2.4.3. the discussion includes the history and definitions of clinical pathways, the benefits of clinical pathways, barriers to clinical pathway development as well as examples of successful clinical pathways in practice.

2.4.1 History

Clinical pathways were first introduced in the field of engineering during the 1950s. During the 1980s, a group of clinicians in the United States of America began using clinical pathways as a strategy for managing healthcare. The aim was to refine care delivery and to identify measurable outcomes, thereby

focusing on the patient instead of the healthcare system (Audimoolam, Nair, Gaikwad & Qing 2005:[1]). The focus of implementing clinical pathways was to improve quality care.

Various synonyms are used to describe the concept of clinical pathways, for example care path, critical pathway, clinical pathway and integrated care pathway (Kwan 2007:189). Despite the semantic differences, the concept has three important elements, namely, (i) a plan of care, (ii) it is developed by a multidisciplinary team and (iii) it is applicable to all aspects of care (assessment, diagnosis, investigation, treatment) as described by Kwan (2007:190). Audimoolam *et al.* (2005:[1]) add that pathways also include a specific timeline and specific interventions that have to take place and specific patient outcomes, as well as a variance record.

According to the draft definition of the European Pathway Association (2005:[1]), the main purpose of a clinical pathway is to improve the quality of care delivered to patients by simultaneously improving patient outcomes, patient safety, patient satisfaction, and the efficient use of available resources. Audimoolam *et al*. (2005:[1]) define clinical pathways as multidisciplinary plans or blueprints of best clinical practice for specific groups of patients with a particular diagnosis that aid in the delivery of high quality care.

2.4.2 Benefits

The cost of health care has risen steadily over the past decade, and healthcare professionals are constantly being pressured to deliver high quality care but also to be cost-effective. The increase in cost can be attributed to several factors, including advances in medical technology and an ageing population (Dy, Garg, Nyberg, Dawson, Pronovost, Morlock, Rubin, Diener-West & Nu 2003:638; Lombardo *et al*. 2008:45).

Shi, Su and Zhao (2008:[1]) state that clinical pathways are methods for standardising and optimising patient care and should be seen as ways of

streamlining essential activities in this regard in order to improve patient outcomes. This process also enhances communication and collaboration among members of the multidisciplinary team.

2.4.2.1 Quality improvement strategy

Kwan (2007:190) states that the fact that clinical pathways can be used as an organisational strategy for improving care and simultaneously reducing costs is one of the major benefits of using clinical pathways. Panella *et al.* (2003:509) agree that the development and implementation of clinical pathways have the potential to enhance patient outcomes and simultaneously provide organisations with an effective method for controlling variances in healthcare. They conclude that clinical pathways should be used as evidence-based methods in an overall quality improvement strategy (Panella *et al.* 2003:515).

Cannon (2008:229) found that the implementation of a clinical pathway for the management of patients suffering acute ischemic and other vascular events, such as ST-elevation myocardial infarction, improved the quality of care for these patients and minimised the response time needed to treat the patients effectively with appropriate drugs. This shortened the length of the recovery to normal quality of life.

In a cluster randomised trial conducted by De Luca, Tonia, Lauria, Sacchetti, Rossi, Ferri, Puca, Prencipe and Guasticchi (2009:[9]), it was suggested that the implementation of a clinical pathway for stroke patients might facilitate the appropriate and homogeneous management of patients. This is consistent with the views of Munitiz, Martinez-de-Haro, Ortiz, Ruiz-de-Angulo, Pastor and Parrilla (2010:717). A clinical pathway allows for the standardisation of care, which improves the safe management of the patient and reduces patient complaints and litigation claims (Pearson *et al.* 1995:942; Panella *et al.* 2003:509; Kwan 2007:191).

Kurtin and Stucky (2009:894) found that the standardisation of care through the implementation of clinical pathways has lead to a reduction in disparities in care delivery for certain groups of patients. They conclude that the implementation of

clinical pathways may address some of the challenges associated with delivering high quality care. These challenges include care that is safe, timely, effective, efficient, equitable, and patient and family centred (Kurtin & Stuck 2009:893). This is consistent with the view of Kwan (2007:190).

Healthcare providers are constantly under pressure to provide care that is cost-effective, whilst maintaining the high quality of care. Dy *et al.* (2003:638) state that the use of clinical pathways might address this pressing issue. The patient goals set out by the clinical pathway guide the multidisciplinary team to sequence the correct actions at the correct time in order to achieve these goals more efficiently, and thereby reduce the cost of hospitalisation and length of stay. This is consistent with the views of Rotter, Kugler, Koch, Gothe, Twork, Van Oostrum and Steyerberg (2008:[2]).

In a study conducted by Munitiz *et al.* (2010:717) it was found that, in patients undergoing transthoracic oesophagectomy, the length of stay was significantly reduced in the group randomised to the clinical pathway.

2.4.2.2 Collaboration

Another important benefit of using the clinical pathway is the improved communication and collaboration among members of the multidisciplinary team (Kwan 2007:192). Rotter *et al.* (2008:[2]) agree that clinical pathways should be developed through the collaborative efforts of the entire multidisciplinary team. Accordingly, these efforts could enhance communication between members of the multidisciplinary team and simultaneously facilitate better patient outcomes (Pearson *et al.* 1995:947; Kurtin & Stucky 2009:903).

Kurtin and Stucky (2009:894) also conclude that the use of clinical pathways could assist in bridging the gap between knowledge and practice through the continuous revision and updating of the clinical pathway as new research evidence becomes available, thus ensuring that patients and multidisciplinary team members benefit from new developments in healthcare.

2.4.2.3 Control over variances

The constant threat of malpractice suits could be alleviated by the implementation of evidence-based clinical pathways, as the clinical pathway provides the multidisciplinary team with a clear map of the treatment plan for a specific patient. Any deviation from the plan can be carefully documented to support the clinical decision (Pearson *et al.* 1995:946; Audimoolam *et al.* 2005:[1]); Kwan 2007:190).

2.4.3 Barriers

Despite the advantages of using clinical pathways, there are still barriers to the development and implementation of clinical pathways in practice today. The two main aspects have been identified as barriers to clinical pathway development, namely resources and physician's perceptions, and will be discussed in Section 2.4.3.1 and 2.4.3.2.

2.4.3.1 Resources

The development of clinical pathways requires the allocation of scare resources, for example time and money. Although the benefits are clear, these barriers need to be taken into account when developing and implementing a clinical pathway (Kwan 2007:191; Kurtin & Stucky 2009:895).

Clinical pathways need be constantly updated to ensure that the information remains clinically relevant, and this can become time consuming (Goyal, Stant, Esposito, Piri, Collins, Sayan, Neuberg, Miller, Moses, Stone, Giglio, Rabbani 2008:211)

2.4.3.2 Physician's perceptions

Pearson *et al.* (1995:946) and Kwan (2007:191) agree that physicians' perceptions of clinical pathways are still a major barrier. Physicians often interpret the use of clinical pathways as "cookbook medicine" rather than an attempt at standardisation and quality improvement.

Physicians are often reluctant to implement clinical pathways because they are perceived as a way of constraining their clinical judgement in an effort to reduce costs (Pearson *et al.* 1995:946). Consequently, involving physicians during the development of a clinical pathway might help to alter this perception, as physicians stand to gain more control over the care of their patients by being actively involved in the process (Kurtin & Stucky 2009:903; Munitiz *et al.* 2010:718).

Chew, Kausar and Sturman (2008:11) recognise collaboration between the members of the multidisciplinary team as being vital to the successful implementation of a clinical pathway. In this regard, Munitiz *et al.* (2010:718) note that multidisciplinary teams should be encouraged to participate in the process. In addition, Kurtin and Stucky (2009:903) conclude that using clinical pathways not only addresses issues related to delivering high quality care, but also creates learning opportunities during which members of the multidisciplinary team can improve current practice.

2.4.3.3 Examples

Cannon (2008:229) states that the implementation of clinical pathways could potentially improve the quality of care and optimise patient care. Additionally, clinical pathways can be implemented as a strategy for reducing the underutilisation of resources and facilitating communication between members of the multidisciplinary team at various levels. This is consistent with the views of Dy *et al.* (2003:638).

A hospital in Denmark conducted a study to assess the effect of a clinical pathway on the recovery of patients after colonic resection (Basse, Jakobsen, Billesbølle, Werner & Kehlet 2000:55). Subsequently, it was found that the length of hospital stay was reduced as were the number of post-operative complications generally experienced by these patients.

Dufault and Willey-Lessne (1999:31) studied the effects of a clinical pathway on pain management. It was found that the patients randomised to the new clinical pathway experienced less pain and were better able to participate in activities of

daily living for example walking and sleeping. The authors conclude that the evidence strongly supports the use of clinical pathways.

Evans, Reading and Fox (2008:23) published two successful clinical pathways for the management of maternity patients. By using these clinical pathways the time needed for managing patients presenting with obstetric emergencies was greatly reduced. This, in turn, enhanced patient satisfaction levels.

In another study, a hospital in Australia implemented a clinical pathway for the management of adult patients in the emergency department who are febrile following chemotherapy. Salter (2005:32) concludes that the implementation of the clinical pathway resulted in the speedy assessment and appropriate treatment of the patient in a shorter time period. The care of these patients could also be standardised, which means that the patients received optimal care from both experienced staff and less experienced staff in the unit.

2.5 CONCLUSION

Chapter 2 provided an overview of the anatomy and physiology of respiration, mechanical ventilation, ventilator modes, invasive and noninvasive ventilation, and clinical pathways. The benefits of NIV have been established through research, but these benefits are still not reaching the patients they are intended for. From the literature reviewed, it would seem that clinical pathways may be beneficial as a strategy for improving quality of care.

Chapter 3 will provide an in-depth discussion of the research methodology employed in this study.

3 THE METHOD

3.1 INTRODUCTION

Chapter 2 provided a literature review on topics related to the anatomy and physiology of respiration and mechanical ventilation. This chapter will provide an in-depth discussion of the specific method employed in this study.

The method includes a discussion on the research design and methodology utilised to address the aim of the study.

3.2 RESEARCH DESIGN

Polit and Beck (2008:765) describe research design as "*the overall plan for addressing a research question, including specifications for enhancing the study's integrity".* This is consistent with the view of De Vos, Strydom, Fouche and Delport (2002:137), as well as with Gillis and Jackson (2002:92). The choice of research design needs to be the design most appropriate for the research question (Mateo & Kirchhoff 1991:167; Gillis & Jackson 2002:14; Brink 2006:118).

The following section provides the rationale for using a design that is qualitative, contextual, explorative and descriptive in nature (see Section 3.2.1 to 3.2.4)

3.2.1 Qualitative design

Qualitative research designs are used when there is a need for an in-depth investigation of the phenomenon of interest which requires the use of a flexible research design (Gillis & Jackson 2002:179; Polit & Beck 2008:763). For the purpose of this study, Creswell's (2007:37) definition of qualitative research was adopted: "*Qualitative research begins with assumptions, a worldview, the possible use of a theoretical lens, and the study of research problems inquiring into the meaning of individuals' or groups' attribute to a social or human phenomenon."* The human experience of the phenomenon under study will require thorough exploration, and therefore a qualitative approach was used in the context of this study. The phenomenon under investigation in this study was the components of a clinical pathway for NIV.

A qualitative approach is the most appropriate for explorative inquiry, and hence such an approach was adopted for exploring the components of a clinical pathway for NIV. Qualitative research methods are often categorised as emergent designs owing to the fact that there is little known about the phenomenon under investigation and the researcher has to make design decisions according to the new information discovered during the course of the study (Burns & Grove 1993:27;Polit, Beck & Hungler 2001:207).

Six characteristics of qualitative research design have been identified (Streubert & Carpenter 1995:10; Polit *et al.* 2001:207; Polit & Beck 2008:219). The application of these characteristics to this study is delineated in Table 3.1.

Table 3.1 Application of the characteristics of qualitative research design

Characteristic	Application
Flexible and elastic, capable of adjusting to what is being learned during the course of data collection	The researcher is able to gather more complete data from the participants owing to the wide variety of views on the phenomenon under study.

Characteristic	Application
Typically involves the merging of various data collection strategies	The researcher is able to adjust the data collection technique to obtain the best possible data to answer the research question, e.g. brain storming sessions, individual ideas and focus groups.
Tends to be holistic, striving for an understanding of the whole	All data collected during the study are included in the analysis which lends itself to more complete and interesting descriptions of the phenomenon, and not fragmented ideas.
Requires the researcher to become intensely involved, usually remaining in the field for lengthy periods of time	The researcher is a member of a multidisciplinary team and has an emic perspective on the phenomenon. The researcher spends more time in the field but gains complete understanding. The research takes place in a naturalistic setting – where the phenomenon is naturally found.
Requires the researcher to become the research instrument	The researcher is part of the study and is responsible for various aspects of the inquiry, including data collection and analysis. The participation of the researcher has the potential to add to the richness of the data.
Requires ongoing analysis of the data to formulate subsequent strategies and to determine when field work is done	The researcher analyses the data after collection (phase 1) to decide whether the data collection strategy is still appropriate for this study and how to improve the data collection if needed.

Source: Adapted from Polit et al. (2001:207)

As evident from Table 3.1, a qualitative research design is applicable to this study to provide answers to the research question.

3.2.1.1 Elements of qualitative inquiry

In the view of Gilles and Jackson (2002:186), in order to further substantiate the use of a qualitative design, the following elements are considered valuable:

⇨ **Multiple realities exists**

There are multiple realities or truths to consider. Furthermore, the researcher is responsible for identifying these realities and the ways in which the participants' views are constructed around what they believe to be true.

⇨ **Identification of perspectives**

Qualitative methods are employed when there is a need to fully explore a phenomenon when little is known about it. The research design decision is then derived from the new information gathered, and not from a preset design. Consequently, data collection methods are chosen that obtain the most complete data from participants.

⇨ **Commitment to the participants**

The researcher becomes deeply involved with the participants and is able to fully immerse him- or herself in the setting. Accordingly, the researcher is often a co-participant and seeks to understand the participants' point of view.

⇨ **Natural context**

The researcher collects data about a phenomenon in the setting where the phenomenon naturally occurs.

⇨ **Insider's view**

In this study, the researcher is a member of the multidisciplinary team involved in managing patients receiving NIV.

⇨ **Rich description**

Participants were given the opportunity to make written comments in respect of the draft documents (see Annexure D2).

3.2.2 Contextual design

Babbie and Mouton (2001:272) state that research should be conducted in the natural context in which the phenomenon occurs, and that the researcher should aim to understand the phenomenon as it occurs in this context. It is the opinion of Creswell (2007:37) and Polit and Beck (2010:261) that qualitative researchers usually collect their data in real-world, naturalistic settings. Hence, qualitative researchers tend to collect data in the field at the site where participants experience the issue or problem under study.

The researcher aimed to develop a clinical pathway for NIV in collaboration with the multidisciplinary team working in a specific CCU in Gauteng. The intention of which was to establish a clinical pathway that could be used for the NIV of adult patients presenting with ARF, which could benefit the healthcare professionals, the patients and the healthcare system, as suggested by Kwan (2007:192).

3.2.3 Explorative design

Explorative studies are used to investigate the full complexity of the phenomenon of interest, as well as the underlying factors that contribute to its existence, in order to gain a better understanding of the phenomenon (Polit & Beck 2008:20).

Gerrish and Lacey (2006:20) maintain that qualitative, explorative designs are appropriate when little is known about the phenomenon of interest, and when the purpose of the research is to explore rather than to explain.

3.2.4 Descriptive design

Descriptive research is aimed at describing the full complexity of the phenomenon under study, as well as the importance of the phenomenon (Polit & Beck 2008:19). According to Rubin and Babbie (2001:125), “description” refers

to an intensive examination of phenomena and their deeper meanings, thus leading to a more detailed description of the phenomenon under study.

Babbie and Mouton (2001:80) and Burns and Grove (2005:240) state that the major purpose of many socio-scientific studies is to portray the characteristics of persons, groups, situations, events and/or the occurrence frequency of certain phenomena accurately as they naturally happen. The purpose of this study was to describe the components of a clinical pathway for NIV in a CCU.

3.3 RESEARCH METHODOLOGY

Research methodology can be defined as the techniques employed by researchers to structure the study, as well as to collect and analyse the data (Polit *et al.* 2001:13; Gillis & Jackson 2002:92; Polit & Beck 2008:15). Thus, research methodology comprises of the population, sampling, sample, data collection and data analysis utilised in the different phases of the study.

This study consisted of three phases and is colour coded to direct the methodology. These phases are:

- Phase 1: Components of the clinical pathway
- Phase 2: Literature control
- Phase 3: Develop the clinical pathway

3.3.1 Population

The population of a study can be defined as the entire collection of persons or subjects that the researcher is interested in studying, and who meet the set inclusion criteria (Brink 2006:123; Polit & Beck 2008:337). The accessible population, on the other hand, refers to the portion of the population that is accessible to the researcher for participation in the study (Gillis & Jackson 2002:497; Polit & Beck 2008:337), whereas the target population can be defined

as the total population that forms the focus of the study, or to whom the results will be generalised (Gerrish & Lacey 2006:173).

The population remained the same for Phases 1 and 3. The population consisted of all the members of the multidisciplinary team currently working in the CCU, who are involved in the management of patients receiving NIV, namely nurse practitioners, physiotherapists and physicians.

3.3.1.1 Eligibility criteria

The eligibility criteria describe the characteristics that participants should possess in order to be included in the population. These characteristics are also referred to as inclusion criteria (Polit & Beck 2008:338).

The inclusion criteria for this study are:

- member of the multidisciplinary team currently working in CCU
- previous experience with NIV
- nurse practitioner, physiotherapist or physician

3.3.2 Phases

The research methodology was divided into three phases. Phase 1 consisted of three steps, as seen in Figure 3.1, which is a schematic representation of the research process. Step 1 refers to the exploration of the components that need to be included in the clinical pathway. From this point forward, Step 2 comprised a brainstorming session during which the groups developed individual clinical pathways. A group discussion was then held during which consensus was reached on the components of the clinical pathway.

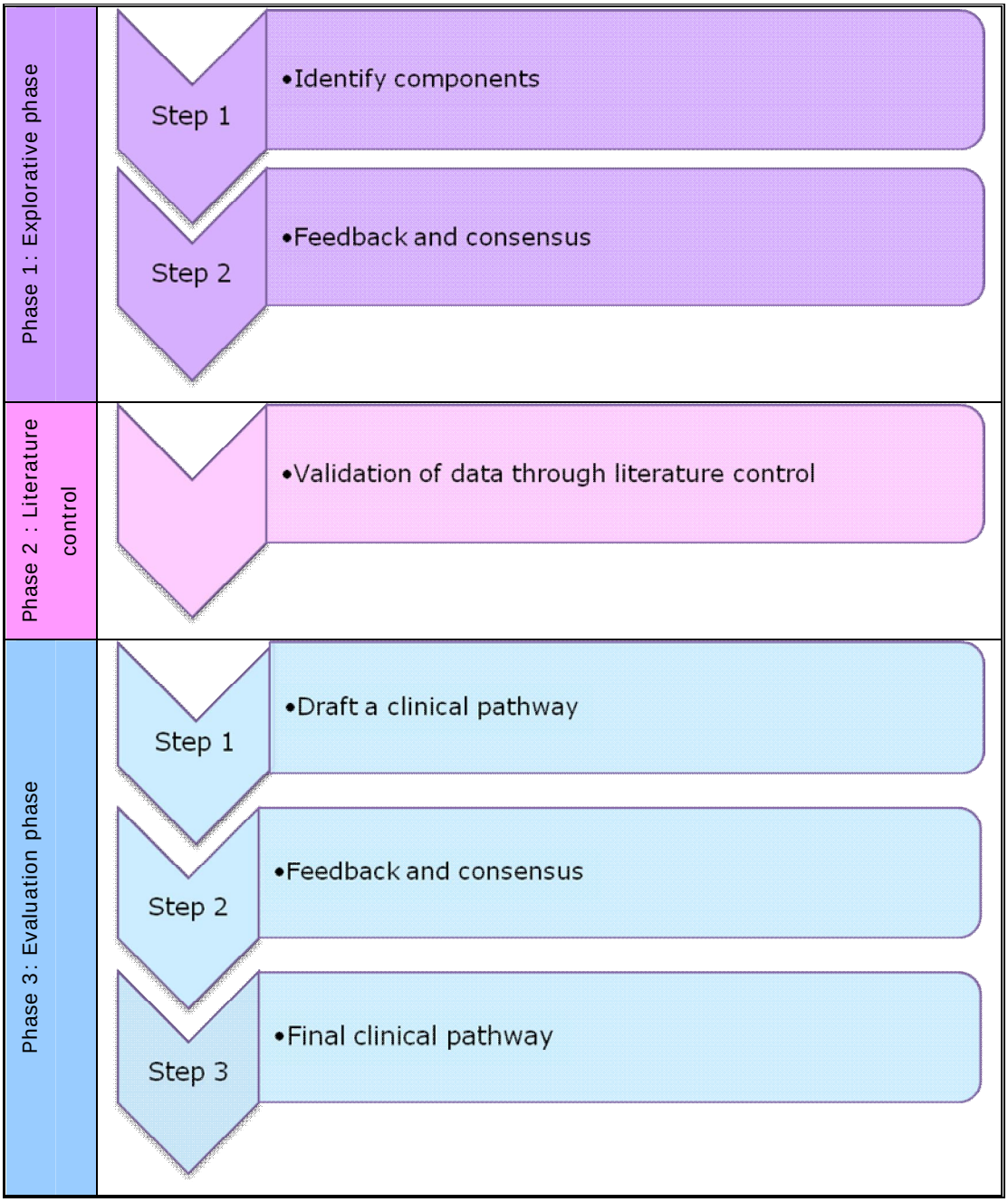

Figure 3.1: Schematic representation of the research process

The data collected during the brainstorming session in Phase 1 as well as the data collected from the individual groups was verified during Phase 2 by means of a literature control.

Phase 3 consists of three steps, namely Step 1, during which a draft clinical pathway was developed by the researcher based on the research findings of Phases 1 and 2. During Step 2 feedback and consensus on the draft clinical pathway were obtained and participants were requested to evaluate the clinical pathway using the attached evaluation instrument. A final clinical pathway was developed during Step 3, using the written feedback from the participants.

Phase 1: Components of the clinical pathway

The research methodology as applied to Phase 1 is discussed in depth, including sampling, sample, data collection and data analysis.

Phase 1 consists of two steps, namely:

- Step 1: Identify components
- Step 2: Feedback and consensus

Each step will be discussed.

3.3.2.1 Step 1: Identify components

⇨ **Sampling**

Sampling refers to the process of selecting a portion of the population to represent the entire population. Accordingly, a sample is seen as a subset of the population (Brink 2006:123; Polit & Beck 2008:339). The eligibility criteria are used to determine the target population required for the study (Burns & Grove 1993:403).

For the purpose of this study non-probability sampling was used. Non-probability sampling is generally used in nursing research but might not yield a representative sample (Gillis & Jackson 2002:504; Gerrish & Lacey 2006:176; Polit & Beck 2008:341). The nonprobability sampling method employed in this

study is purposive sampling. Purposive sampling refers to the selection of participants who are thought to be particularly knowledgeable on the phenomenon of interest (Gillis & Jackson 2002:507; Gerrish & Lacey 2006:182; Polit & Beck 2008:343).

Purposive sampling is based on the premise that the researcher's knowledge of the population can be used effectively to select participants who would be able to make a contribution to the study (Gillis & Jackson 2002:507; Gerrish & Lacey 2006:182; Polit & Beck 2008:343)

Purposive sampling was employed during this phase of the study. This type of sampling refers to the selection of participants who are thought to be particularly knowledgeable on the phenomenon of interest (Gillis & Jackson 2002:507; Gerrish & Lacey 2006:182; Polit & Beck 2008:343). The participants were requested to complete the informed consent form prior to the commencement of the study (see Annexure B1 to B3) as well as a registration form. The data pertaining to the participants will be discussed in the section regarding the sample.

Non-probability samples are often not representative of the population, and some element is likely to be over or under represented. Despite this, non-probability sampling is most often used for nursing studies on the basis of its qualities of economy and convenience (Gerrish & Lacey 2006:175; Polit & Beck 2008:344).

For the purposes of this study, purposive sampling was most suited to answering the research question.

⇨ Eligibility criteria

For the purposes of this study participants were purposively selected members of the multidisciplinary team currently working in the CCU. He or she had had previous experience with NIV and encompassed at least one of the following eligibility criteria:

o nurse practitioner

- physiotherapist, or
- clinical technologist

⇨ **Sample**

The following section provides a detailed description of the participants involved in Phase 1 of this study. The researcher made use of purposive sampling to recruit the participants for the study.

The participants were requested to complete a registration form prior to the commencement of the brainstorming session. The participant information that the researcher deemed important for the study is delineated in Table 3.2, according to the questions posed on the registration document (see Annexure B2).

The following characteristics have been included for discussion in this section:
highest qualification obtained

- years experience in critical care
- years experience with mechanical ventilation
- years experience with noninvasive ventilation

Table 3.2: Phase 1: Participant characteristics

Highest qualification obtained	Number
PhD	**2***
MCur	**1***
BCur Honours	**1***
Registered nurse: Critical care training	**8***
Registered nurse: Critical care experience	**3**
National diploma: Clinical technology	**2***

Some participants have more than one qualification

A total of 15 participants voluntary participated in Phase 1. Of the 15 participants, 13 were registered nurses with various nursing qualifications and two of the participants were clinical technologists specialising in mechanical ventilation. All the participants were involved in critical care at some level.

Table 3.3 provides information regarding the participant's level of experience according to the criteria outlined in Section 3.3.2.1 above, namely years' experience with mechanical ventilation and years' experience with NIV.

Table 3.3: Phase 1: Participant's level of experience

Years of experience	<5	>5	>10	>15
Years' experience in critical care unit	3	5	4	3
Years' experience with mechanical ventilation	3	5	3	3
Years' experience with NIV	5	5	2	

All the participants had some level of experience with regard to NIV. From the table above it is evident that five of the participants had fewer than five years' experience with NIV. The participant's level of experience can be plotted on a graph, as depicted in Figure 3.2.

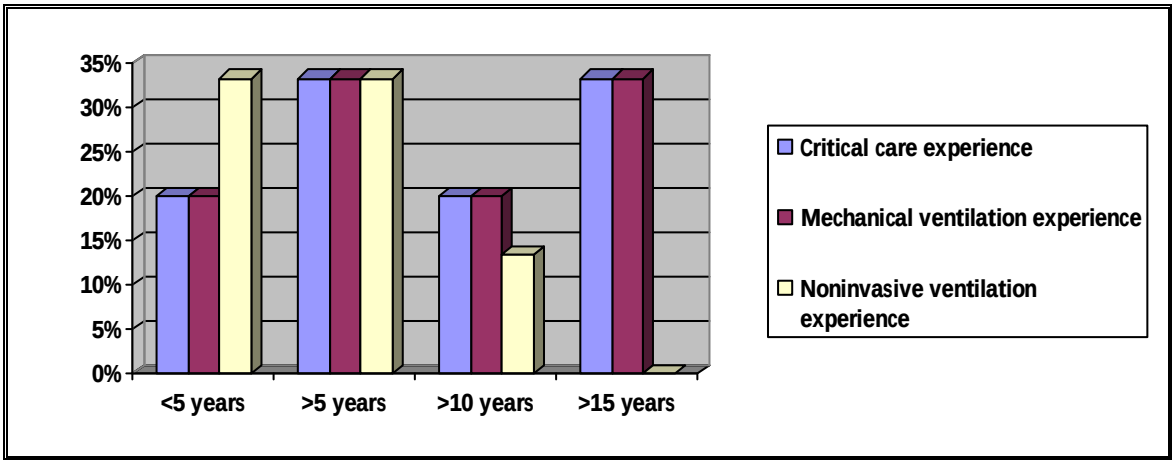

Figure 3.2: Phase 1: Participant's level of experience

The graph shows that the participants who have five to ten years critical care experience have more experience with NIV. This can be attributed to the fact that NIV has gained popularity during the past decade as an alternative to invasive ventilation (Plant *et al.* 2003:[1]; Hill *et al.* 2007:[1]; Endorf & Dries 2010:217).

⇨ Data collection

During Step 1 of Phase 1 the data were collected by means of a brainstorming session. The intention of this session was to identify the components that should be included in a clinical pathway for NIV. Brainstorming is considered to be an unstructured data collection technique (Kimel 2003;Polit & Beck 2008:394). It is also regarded as an effective method for generating multiple ideas and alternative solutions to problems (Polit *et al.* 2001:265; Gilles & Jackson 2002:235; Kreitner & Kinicki 2007:390).

In the context of qualitative research, brainstorming constitutes a form of focus group interview and is considered to be highly effective in generating rich data, which are further enhanced by the interaction between the group members (Polit *et al.* 2001:265; Gillis & Jackson 2002:235; Polit & Beck 2008:394). This is consistent with the views of Kreitner and Kinicki (2007:390).

The brainstorming session was held in the seminar room at the University of Pretoria where the researcher is a student. Four tables were set – one for each sub-group. The participants were seated around the table in order to facilitate and enhance communication between the participants. The tables were spaced slightly apart to prevent the groups from disturbing or interrupting one another. The room was prepared in advance to ensure that the conditions were conducive to brainstorming by, for example, ensuring adequate lighting and ventilation. Water jugs and glasses were set on each table as well as small bowls containing a selection of sweets, for example mints and chocolates.

Figure 3.3: Phase 1: Example of the brainstorming session

The participants were divided into four sub-groups. Three of the four groups consisted of four participants and one group consisted of three. The researcher divided the participants into the sub-groups prior to the commencement of the session in order to ensure that all the participants in a group were not employed at the same institution. This yielded rich data with multiple viewpoints regarding NIV. The researcher ensured that each group consisted of least one nurse practitioner and one physiotherapist.

Each group was 'colour coded' and supplied with the same colour paper as depicted in Table 3.4.

Table 3.4: Phase 1: Colour distribution of the small groups

Group	Colour
Group 1	Blue
Group 2	Pink
Group 3	Yellow
Group 4	Green

The steps followed during the data collection are discussed to provide insight into the data collection process. The data collection process consisted of seven steps:

- ***Step 1*:** Tea and coffee and rusks were provided prior to the commencement of the brainstorming session. The participants were welcomed and thanked for their participation. The researcher used a PowerPoint slide show that had been prepared in advance to make the participants aware of the aims and objectives of the study, the estimated timeframe of the session as well as the expectations of the participants. The rationale for the group allocations was also explained. At this point the participants were given time to complete the informed consent form as well as to ask questions pertaining to the study. Once informed consent had been obtained from all the participants, the session continued.
- ***Step 2:*** Introduction to the study and the aims and objectives of the study. This was done in the form of a PowerPoint slide show presented by the researcher as explained above. Informed consent was obtained from the participants. An expert in the field of clinical pathways was asked to give a

short introduction regarding clinical pathways and their value in practice development. The participants were then given an opportunity to ask questions.

- ***Step 3*:** Reach consensus on the ground rules for this brainstorming session. Kreitner and Kinicki (2007:391) suggest the following ground rules, which will be borne in mind:
  - *Defer judgement*: Do not criticise during the initial stage of idea generation – phrases such as "it won't work", or "management will never agree" or "everybody will never follow the same clinical pathway" should not be used.
  - *Build on the ideas of others*: Encourage out-of-the-box thinking – the wider or more outrageous the ideas the better.
  - *Go for quantity over quality*: Participants should try to generate and write down as many new ideas as possible – focusing on quantity encourages people to think beyond their favourite ideas.
  - *Be visual:* The use of different coloured pens for writing on coloured paper could further encourage creative thinking.
  - *Stay focused on the topic*: The facilitator should keep the discussion on target and walk between the groups to ensure the group members stay focused.
  - *One conversation at a time*: The ground rule applies that no one should interrupt another person, there should be no dismissing of someone else's ideas, no disrespect and no rudeness.
  - *Encourage participation*: The group members will be granted the opportunity to add to the ground rules.
- **Step 4:** Individual participants were asked to silently generate ideas or alternatives to the open-ended questions which were written up on the white board. The questions included the following:
  - What should the ***assessment*** of a patient include to determine whether NIV is suitable for this patient?
  - What other data are important when assessing the patient's health status (baseline data)?
  - What should be included in ***planning*** for the initiation of NIV for the patient presenting with ARF?
  - How would you ***implement*** NIV for the patient presenting with ARF?

- What data should be taken into account when deciding to implement NIV?
- What data should be included when ***evaluating*** the patient's response to NIV?

o ***Step 5*****:** The participants were allowed time to silently generate ideas using the notepads and pens supplied to each participant. This step was included, as silent generation is preferable to the practice of having group members randomly shout out their ideas and often leads to a greater number of unique ideas (Kreitner & Kinicki 2007:390). The time allowed for this activity was 15 minutes.

o ***Step 6:*** Following this period the participants were asked to share their ideas within their sub-groups and reach consensus among themselves regarding the components of the clinical pathway. The participants were asked to write down their answer on the coloured paper provided for each group. The time allocation for this activity was approximately one hour and 15 minutes.

o ***Step 7:*** Individuals shared their ideas/alternatives with the sub-group members. The group discussed the alternatives for inclusion in their draft clinical pathway. Each sub-group identified the components of the clinical pathway on the coloured paper provided, according to the questions asked during Step 4.

On completion of this activity, the participants were given 30 minutes to relax and enjoy a light meal.

⇨ **Data analysis**

The data analysis of Step 1 was conducted concurrently with the data obtained during Step 2. See Section 3.3.2.2, data analysis.

3.3.2.2 Step 2: Feedback and consensus

Step 2 of Phase 1 continued after the light meal. Each sub-group has identified the components of the clinical pathway for NIV.

⇨ **Sample**

The same sample remained the same as during Step 1 of Phase 1. See Section 3.3.2.1.

⇨ Data collection

Step 2 of Phase 1 was facilitated by an expert in the field of research. The facilitator asked each group individually to share their ideas with the other groups. The groups each appointed a spokesperson and were given an opportunity to voice their opinion. The other groups were then asked one at a time if they agreed with the data and if they had anything to add. This process continued until the four questions posed by the researcher had been answered. Input from all sub-groups was used in a "think tank" to reach consensus on the components to be included in the clinical pathway. The facilitator then discussed each component separately and the groups were asked if they agreed. If consensus was reached the facilitator noted it verbally (session was recorded) and moved on to the next idea for discussion.

Step 2 of Phase 1 was concluded after 45 minutes. The researcher thanked everyone for their valuable input, and the session was concluded. The researcher acted as observer/mediator during the brainstorming session (Polit & Beck 2008:394). Once consensus was reached, the participants were thanked for their input and refreshments served. The participants received a light meal on completion of Phase 1.

⇨ Data analysis

The analysis of qualitative data involves the identification of relevant themes and categories (Brink 2006:185). Polit and Beck (2008:507) describe the purpose of data analysis as being to *"… organize, provide structure to, and elicit meaning from research data".*

The data collected from the individual written feedback, brainstorming ideas of each sub-group, the data collected during the consensus discussions pertaining to the components of the clinical pathway as well as field notes, were used during the data analysis process.

Qualitative data is commonly analysed by means of content analysis, where prominent themes and categories are identified (Polit *et al.*, 2001:394; Gerrish & Lacey 2006:427; Polit & Beck 2008:517). Content analysis is an analytical method for the systematic analysis of written or verbal data (Gillis & Jackson 2002:253); it can be done inexpensively and with a fair degree of validity as a result of the direct observation and classification of data (Gilles & Jackson 2002:253).

The researcher was guided by the nursing process, utilised as the conceptual framework, to formulate four themes from the data, namely assessment, planning, implementation and evaluation. The categories identified within each theme, as well as the data collected from the four groups during the brainstorming session, will be discussed in Chapter 4. From these main themes, the data for each theme were categorised and coded. The researcher was responsible for the coding as it is advisable for one person to take responsibility for the coding of all the data in order to enhance consistency of the coding as suggested by Polit and Beck (2008:511).

In a qualitative content analysis the data are broken down in smaller units; they are then coded and named according to the content they represent (Polit & Beck 2008:518). "*Coding"* in this context means to attach a label to the data and to categorise them according to the labels (Gerrish & Lacey 2006:219, 427). Coloured paper was used to assist in coding the data according to the themes, for example, participants were supplied with coloured paper for writing down the phase 1 data according to their group allocation (see table 3.4). The coloured pages were marked with the following headings:

- assessment data
- planning data
- implementation data
- evaluation data

The groups wrote their answers on the applicable pages. Subsequently, the researcher grouped the coloured pages together, and filed the pages in a conceptual file. These data were also included in the data analysis process.

The audio taped transcriptions of the sub-group discussion session during Step 2 are included as evidence (see Annexure C7). A discussion of the data which the groups reached consensus on is included in this section followed by the supporting and/or conflicting literature pertaining to the data.

Phase 2: Literature control

A literature control refers to the thorough search of existing literature on the selected topic, and this is done to familiarise the researcher with the existing knowledge base on the topic (Burns & Grove 1993:142; Polit *et al.,* 2001:120; Gillis & Jackson 2002:76; Polit & Beck 2008:105).

Burns and Grove (1993:142) state that a literature review provides the researcher with the necessary background for conducting a study. This is consistent with the views of Polit *et al.* (2001:120) and Polit and Beck (2008:106). A literature review forms the foundation for conducting a new study (Polit *et al*. 2001:121). For the purposes of this study the researcher conducted a preliminary literature review to establish what is known about the use of NIV (see Chapter 2). This assisted in identifying and refining the research problem, as well as in the selection of a conceptual framework suited to the study.
The researcher conducted a comprehensive literature control as part of Phase 2 of the study to confirm and verify the data collected during the brainstorming session (see Chapter 4). The data from the brainstorming session as well as information gleaned from the literature were combined to develop the draft clinical pathway at the end of phase 2.

Polit *et al.* (2001:121) also identify other relevant aspects of the literature review, which assisted the researcher during the study:

- identification of a research problem and development and refinement of research questions
- orientation to what is known about an area of inquiry to ascertain what research can best make a contribution to knowledge

- determination of any gaps or inconsistencies in a body of research
- determination of a need to replicate a prior study in a different setting or with a different study population
- identification of relevant theoretical or conceptual frameworks for a research problem
- identification of suitable designs and data collection methods for a study
- assistance in interpreting study findings and in developing implications and recommendations

The researcher has conducted a literature control in an effort to validate the components of the clinical pathway identified by the sub-group, as suggested by Walsh (1998:85).

Phase 3: Develop the clinical pathway

Phase 3 of the study consisted of three steps, namely:

- Step 1: Draft a clinical pathway
- Step 2: Feedback and consensus
- Step 3: Final clinical pathway

Each step will be discussed.

3.3.2.3 Step 1: Draft a clinical pathway

On completion of the literature review the researcher redeveloped the draft clinical pathway based on the research finings obtained during Phase 1 as well as the literature control.

3.3.2.4 Step 2: Feedback and consensus

During Step 2 feedback and consensus was reached on the draft clinical pathway.

⇨ **Sampling**

All participants of Phase 1 (see Section 3.3.2.1, sample) were invited to participate in Phase 3. In addition, snowball sampling was employed in order to further verify the data by means of additional participants, for example experts in the field of clinical pathways and pulmonology.

Snowball or network sampling is a non-probability sampling technique (Brink 2006:134; Polit & Beck 2008:341). The participants from Phase 1 were asked to provide the researcher with references for additional participants for Phase 3 of the study, who met the eligibility criteria of Phase 3. The researcher then approached the identified experts to participate in Phase 3.

Informed consent was obtained from the participants (see Annexure B4). The participant characteristics during phase 3 are outlined in the following section.

⇨ **Eligibility criteria**

For the purposes of this study participants were purposively selected members of the multidisciplinary team currently working in the CCU. He or she had had previous experience with NIV and encompassed at least one of the following eligibility criteria:

- nurse practitioner
- physiotherapist,
- clinical technologist, or
- physician

⇨ **Sample**

The following characteristics have been included for discussion in this section:

- highest qualification obtained
- years experience in critical care
- years experience with mechanical ventilation
- years experience with NIV

Table 3.5 provides a summary of the characteristics of the participants according to the criteria listed above.

Table 3.5: Phase 3: Participant characteristics

Highest qualification obtained	Number
PhD	**2***
MCur	**1***
BCur Honours	**1***
Registered Nurse: Critical care trained	**8***
Registered Nurse: Critical care experience	**4**
National diploma: Clinical technology	**2***
BTech: Clinical technology	**1**
Phsyiotherapy	**2**
MBChB (MMED)	**2**

Some participants acquired more than one qualification

A total of 20 participants voluntary participated in Phase 3. The participants included 14 registered nurses, two clinical technologists specialising in mechanical ventilation, two physiotherapists as well as two physicians as seen in Table 3.5.

Table 3.6 outlines the participant's level of experience according to the criteria set out in Section 3.3.2.1.

Table 3.6: Phase 3: Participant's level of experience

Number of years	<5	>5	>10	>15
Years' experience in critical care unit	3	5	5	7
Years' experience with mechanical ventilation	3	6	5	5
Years' experience with NIV	5	5	4	

Table 3.6 shows the varying levels of experience of the 20 participants that participated in Phase 3 of the study.

Figure 3.4 gives a graphic representation of the participant's level of experience as measured according to the following criteria:

- years' experience in critical care unit
- years' experience with mechanical ventilation
- years' experience with NIV

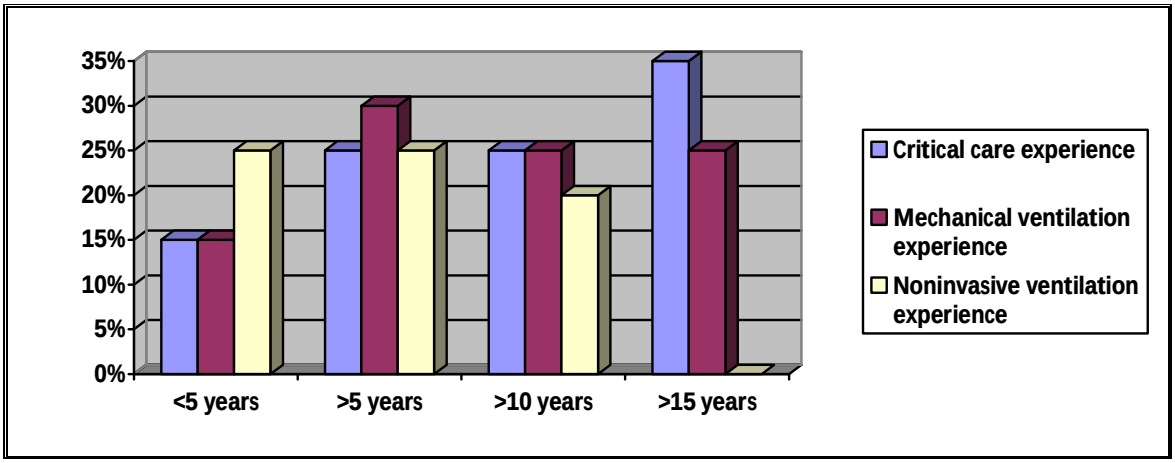

Figure3.4: Phase 3: Participant's level of experience

As evident from Figure 3.4 the participants had varying levels of experience in the critical care setting. The participants' levels of experience with regard to mechanical ventilation and specifically NIV are clearly depicted.

⇨ **Data collection**

During Phase 1, Step 2 the draft clinical pathway, developed during Step 1, was handed to all the participants for review and final inputs. The participants were requested to give written feedback on the content of the draft. The researcher gathered the written feedback provided by the participants as well as the evaluation instrument (see Annexure B4) for final refinement of the draft clinical pathway. The final clinical pathway was then developed.

⇨ **Data analysis**

The comments made by the participants were documented and the draft clinical pathway was refined and finalised based on the feedback received from the participants.

3.3.2.5 Step 3: Final clinical pathway

A final clinical pathway for NIV was compiled by the researcher based on data gathered from Phase 1 of the study, the literature control conducted during Phase 2, as well as the written inputs from participants during Phase 3.

3.4 TRUSTWORTHINESS

According to Polit and Beck (2008:539), the quality of qualitative research can be measured against the standards for trustworthiness. In order to describe the standards of trustworthiness applicable to this study, Lincoln and Guba's framework (Polit *et al*. 2001:312; Gillis & Jackson 2002:215; Polit & Beck 2008:539) has been used. These standards apply to all phases of the study and included credibility, dependability, confirmability and transferability (see Sections 3.4.1 to 3.4.4).

3.4.1 Credibility

Credibility refers to the truth of the data and the confidence in the interpretation of the data. Qualitative researchers should strive to enhance the credibility of the study, and take steps to convey this to the external reader (Polit *et al.* 2001:312; Gillis & Jackson 2002:215; Polit & Beck 2008:539). For the purposes of this study, four strategies were used to enhance the credibility of the research and these will be discussed in Sections 3.4.1.1 to 3.4.1.4.

3.4.1.1 Data triangulation

Polit and Beck (2008:543) describe data triangulation as the use of multiple sources of data to validate the findings of a study. During the data collection phases of this study, data were collected from multiple sources, including the literature and the participants who provided diverse information (Polit *et al.* 2001:313). The intent of data triangulation is to obtain as many diverse views on the phenomenon under study as possible in order to validate the findings (Burns & Grove 1993:277).

3.4.1.2 Method triangulation

Another strategy for enhancing quality in qualitative studies is through method triangulation, which involves the use of multiple data collection methods with regard to the phenomenon under study (Burns & Grove 1993:278; Polit *et al.*

2001:313; Polit & Beck 2008:543). Unstructured data were collected in the form of a brainstorming session, a literature control and feedback from the participants in order to develop the final clinical pathway.

3.4.1.3 Person triangulation

Person triangulation refers to the collection of data from different types or levels of person relevant to the study (Polit & Beck 2008:543). The participants of this study were divided into groups and the members of each group were representative of the different members of a multidisciplinary team, namely nurse practitioners, physiotherapists and support staff. During the third phase of the study, the researcher included the participants from phase 1 as well as the physicians working in the CCU in order to enhance the credibility of the study.

3.4.1.4 Member checking

Another quality enhancing strategy is member checking. Member checking involves providing the participants with feedback on the data and giving them an opportunity to react to it. Member checking can be done throughout the study to ensure that the data are a true reflection of the participants' realities (Polit *et al.* 2001:314; Polit & Beck 2008:545). It is also considered the most important technique for ensuring the credibility of qualitative data (Polit *et al.* 2001:314). For the purposes of this study, member checking was done throughout the data collection and analysis processes.

3.4.2 Dependability

Dependability refers to the stability or reliability of the data over time and conditions (Polit *et al.* 2001:315; Gillis & Jackson 2002:216; Polit & Beck 2008:539). According to Holloway and Wheeler (2002:255), if the findings of a study are to be dependable, they should be consistent and accurate. The setting of the research must also be described in detail and to achieve some measure of dependability an audit trial is necessary. The setting of this research was described in-depth in Section 1.6.1.

The dependability of this study was enhanced through data triangulation. Multiple sources were employed to conduct a literature control during Phase 2 of the research. The researcher kept an audit trail of the research findings as suggested by Babbie and Mouton (2001:278) as well as Burns and Grove (2009:539).

3.4.3 Confirmability

Polit and Beck (2008:539) define confirmability as the objectivity of the data, meaning the possibility that two or more persons would come to the same conclusions about the accuracy and relevance of the data (Polit *et al.* 2001:316 Gillis & Jackson 2002:216). In an attempt to establish the confirmability of the data, the researcher ensured the development of an audit trail, as suggested by Polit and Beck (2008:545) and Gillis and Jackson (2002:216). Data were regularly scrutinised by supervisors at the University of Pretoria in an effort to enhance their confirmability.

3.4.4 Transferability

Transferability refers to the degree to which the findings can be applied to other contexts or with other respondents (Babbie & Mouton 2001:277; De Vos 2002:352; Burns & Grove 2009:539). According to Morse (1994:105) the goal of qualitative research is not to produce generalisation, but rather an in-depth understanding and knowledge of a particular phenomenon. It is the responsibility of the researcher to establish whether criteria can be met in a similar context whilst preserving the original particular findings from a study.

Transferability was enhanced in this study by means of a dense description and purposive sampling (see Table 3.7).

A summary of the measures utilised to enhanced trustworthiness are provided in Table 3.7.

Table 3.6: Summary of the measures utilised to enhance trustworthiness

Method	Strategy	Application
Credibility	Prolonged engagement and persistent observation	The researcher was a member of the multidisciplinary team in CCU at the time of conducting the research
	Member checking	See Section 3.4.1.4
Dependability	Data and method triangulation	See Sections 3.4.1.1 and 3.4.1.2
	Analysis triangulation	Using different units of analysis – focus groups and individual feedback
Confirmability	Comprehensive recording of information	All the data collected during the research process were diligently recorded and filed in a conceptual file
	Person/investigator triangulation	Supervisors at University of Pretoria will have input into analysis and coding decisions
Transferability	Purposive sampling	Phase 1 and 3
	Dense description	Phase 1 to 3

Source: Adapted from Polit and Beck (2008:542)

Table 3.7 provides a summary of the quality enhancement strategies employed as well as the relevant sections containing the discussion of the material.

3.5 CONCLUSION

Chapter 3 outlined the research method, which included the research design and research methodology implemented in this study. The Chapter included an in-depth discussion of the phases delineated to address the research question, aim and objectives. The phases were discussed in terms of the population, samping, sample, data collection and data analysis. Furthermore the methods and strategies to enhance the trustworthiness of the study were discussed.

Chapter 4 will reflect the actual data collection and analysis as well as the literature control that took place during phases 1 to 3 of this study.

4 RESEARCH FINDINGS AND DISCUSSION

4.1 INTRODUCTION

In Chapter 3 the research method was discussed in depth. Chapter 4 will provide an in-depth discussion of the research findings and a discussion thereof as they relate to the literature.

The findings of phases 1 and 2 will be discussed simultaneously to enhance the logical flow of the discussion (see section 3.3). Phase 3 will be discussed separately as the content thereof was derived from phases 1 and 2.

4.2 OVERVIEW OF THE RESEARCH FINDINGS

The themes were based on the conceptual framework which guided the study. The four themes included assessment, planning, implementation and evaluation.

A summary of the themes, categories and sub-categories is provided in Table 4.1. Each of the four themes will be discussed in depth in sections 4.3.1 to 4.3.4. Data collected from the individual groups is included as evidence (see Annexures C2, C3, C4 and C5). The discussion will focus on the categories and sub-categories on which consensus was reached following the brainstorming session.

Table 4.1 Summary of the themes, categories and sub-categories of phase 1 and phase 2

Theme	Categories	Sub-categories
Assessment	History	Age
		Underlying pathology
		Social history
	Prognosis	
	Duration of illness	
	Inclusion criteria	
	Exclusion criteria	Myocardial infarction
		Congestive heart failure
		Asthma
		Facial injuries, fractures and/or abnormalities
		Vomiting, abdominal distension and/or gastro-intestinal bleed
		Recent surgery to upper airway and/or gastro-intestinal tract
		Haemodynamically unstable patients
	Systems orientated assessment	Central nervous system
		Respiratory system
		Cardiovascular system
		Diagnostic tests
Planning	Equipment	
	Patient safety	
	Ventilator settings	
	Patient monitoring	Haemodynamic monitoring
		Arterial blood gas
		Patient comfort
Implementation	Holistic patient care	Patient education
		Spiritual needs
	Initiation of noninvasive ventialtionIV	Patient care
		Multidisciplinary team approach
		Specific observations
Evaluation		

4.3 PHASES 1 AND 2: DISCUSSION OF RESEARCH FINDINGS

The findings gathered during Phase 1 and Phase 2 will be discussed simultaneously.

4.3.1 Theme 1: Assessment

The data obtained from the individual groups during the brainstorming session are summarised in Annexure C2. The data on which consensus was reached following discussion and feedback from the participants are summarised in Table 4.1 (also see Annexure C6.)

The research findings were based on the group discussion and feedback (see Annexures C2 and C6). A discussion of the research findings follows in sections 4.3.1 to 4.3.4. Phases 1 and 2 will be discussed concomitantly as mentioned in section 4.2.

The researcher posed the following questions regarding the assessment of the patient prior to the commencement of NIV.

*What should the **assessment** of a patient include to determine whether NIV is suitable for the patient?*

*What other data are important when **assessing** the patient's health status (baseline data)?*

The questions asked of the participants required them to write down what they thought was important when assessing the patient prior to the commencement of NIV. From the data collected, it was evident that each participant had indicated various aspects of importance related to the assessment of the patient. As predicted by Polit *et al.* (2001:265), Gilles and Jackson (2002:235) and

Kreitner and Kinicki (2007:390), the brainstorming session provided the researcher with multiple ideas and solutions to the question.

In sections 4.3.1.1 to 4.3.1.6 the findings and supportive literature based on the assessment question will be discussed.

4.3.1.1 History

The two main aspects pertaining to the history of the patient that were identified by the participants are age-related concerns and the underlying pathology. Each aspect will be discussed individually.

⇨ Age

All the groups concurred that the patient's age needs to be taken into consideration when deciding whether or not to commence NIV. The patient's age will be a deciding factor, especially for infants and young children. The adult patient who is **not** a candidate for invasive ventilation may be managed by means of NIV, depending on the prognosis and the treatment goals. In addition, Group 3 stated that it is unnecessary to manage a dying patient with NIV. Group 2 felt that NIV could alleviate the patient's suffering and might be of value for dying patients, providing that the treatment goals are kept in mind.

The following quotations pertaining to NIV support the findings related to the age of the patients.

> *"… specific things under assessment in the history that we thought … uh is important … to know what specific age of the patient is …"*
>
> *"… age to us is not factor, unless you're too young …"*
>
> *"… sometimes you'll have a patient that is too old…they do put them on non-invasive …"*

Discussion: The age of the patient is not a deciding factor when considering NIV. According to Essouri, Chevret, Durand, Haas, Fauroux and Devictor (2006:[7]), NIV can be used with success in paediatric patients presenting with ARF resulting from community acquired pneumonia, as well as immunocompromised patients, and recommend that NIV be used as the first-line treatment for these patients.

In a prospective clinical study at a university teaching hospital conducted by Bernet, Hug and Frey (2005:[14]), the use of NIV in infants and children is described as successful with a low complication rate. Furthermore, Sprague, Graff and Tobias (2000:[1]) conclude that NIV is advantageous in the prevention of endotracheal intubation of paediatric patients suffering from cystic fibrosis.

Brochard *et al*. (2002:718) state that NIV for ARF is applied to patients who are poor candidates for invasive ventilation owing to advanced age or "do not resuscitate" directives, for the purposes of providing symptomatic relief. The following authors agree that the patients most likely to benefit from NIV are adult patients with COPD (Gropper 2001:[1]; Elliott *et al*. 2002:1159; Antonelli *et al*. 2005:99; Hill *et al*.2007:[2]; Agarwal *et al*. 2008:741). No specific age group is favoured in any of these studies.

In addition, Scarpazza, Incorvaiai, Di France, Raschi, Usai, Bernareggi, Bonacina, Melacini, Vanni, Bencini, Pravetonni, Di Cara, Yacoub, Riario-Sforza, Guffanti and Casali (2008:799) conducted a study to assess the effect of noninvasive ventilation in elderly hypercapnic patients, and established that age is not a determining factor for the application of NIV. The mean age of the study participants was 81 years, and the mortality rate significantly low at 13%. The authors concluded that elderly patients with ARF resulting from diverse aetiology and do-not-intubate orders can be successfully managed with NIV (Scarpazza *et al*. 2008:800).

⇨ Underlying pathology

Patients with severe asthma, facial injuries and fractures should be excluded as candidates for NIV according to all four groups. Group 4 stated that the patient using oxygen at home should receive special consideration, as most of these

patients suffer from COPD, and should not be excluded from NIV. Group 3 stated that patients suffering from pneumonia in their experience show a marked improvement once NIV has been commenced, and that from their experience COPD patients "… do really well …" when treated with NIV because the work of breathing is reduced, and they have a chance to rest.

The groups agreed that each patient should be assessed individually and not excluded on the basis of certain preconceived ideas, for example that all COPD patients do not "cope" with NIV.

The following quotations support the findings related to the underlying pathology related to the commencement of NIV.

"… determine the underlying pathology…to make sure that the patient is actually a good candidate for non-invasive …"

"… If the prognosis is good like in a pneumonia … that can maybe by short term by non-invasive prevent the patient from being intubated … but if the patient is a poor prognosis, COPD, are on home oxygen, we also do NIV … the prognosis is important but it goes both ways. Good and bad … "

"…Ok many of the things they said we've covered. So it's actually amazing how we all think the same …"

Discussion: Most studies conducted to establish the effectiveness of NIV included COPD patients (Lightowler *et al.* 2003:[4]; Penuelas *et al.* 2007:1211; Robert & Argaud 2007:[4]; Maggiore *et al.* 2010:145). Information on acute respiratory failure due to other aetiologies that might be managed with NIV, as found in the literature, will be discussed in the following section.

- **Acute cardiogenic pulmonary oedema**

Acute hypoxemic respiratory failure occurs when arterial oxygenation levels are severely altered, such as in patients with acute cardiogenic pulmonary oedema. Wysocki and Antonelli (2001:209) concluded that the commencement of NIV in

patients presenting with acute cardiogenic pulmonary oedema leads to the successful reversal of elevated carbon dioxide tension in the arterial blood. With NIV the delivery of high concentrations of oxygen to the patient improves arterial oxygenation, reduces the work of breathing and unloads the respiratory muscles, thereby recruiting alveoli and improving lung volumes (Wysocki & Antonelli 2001:210).

Chadda, Annane, Hart, Gajdos, Raphaël and Lofaso (2002:[7]) state that NIV is an effective non-pharmacological treatment for patients with acute cardiogenic pulmonary oedema, because it reduces the work of breathing, thereby unloading the respiratory muscles. In addition, Hill *et al.* (2007:[3]) suggest that NIV could be applied to patients with hypoxemic respiratory failure resulting from acute cardiogenic pulmonary oedema. Strong evidence exists for the successful application of NIV in patients with acute cardiogenic pulmonary oedema (Hill *et al.* 2007:[3]). This is consistent with the view of Soo Hoo (2010:[16]).

Patients presenting with ARF as a result of acute cardiogenic pulmonary oedema have been shown to respond favourably to biphasic positive airway pressure (BiPAP) and continuous positive airway pressure (CPAP) with significant improvements in vital signs and gas exchange, whilst simultaneously reducing the need for invasive ventilation (Frontin, Bounes, Houzé-Cerfon, Charpentier, Houzé-Cerfon & Ducassé 2010:2).

- **Pneumonia**

An estimated 58 to 87% of patients admitted to the CCU as a result of community acquired pneumonia develop ARF (Wysocki & Antonelli 2001:215). In view of these authors, the commencement of NIV is debatable owing to conflicting data, although smaller studies have shown improved gas exchange after commencing NIV (Wysocki & Antonelli 2001:215).

It is the opinion of Baudouin *et al.* (2002:201) that NIV has been successfully applied in the management of severe community acquired pneumonia. The commencement of NIV improves oxygenation, reduces respiratory rate and relieves dyspnoea. Furthermore, Hill (2003:400) concludes that clinical evidence

exists that patients with COPD complicated by severe community acquired pneumonia do well when treated with NIV.

The management of patients presenting with severe community acquired pneumonia with NIV remains challenging according to Hill *et al.* (2007:[3]), because a large percentage of these patients require invasive ventilation after failing NIV. Those who succeed with NIV have shown very good outcomes, with reductions in hospital stay, intubation rates and mortality rates, but the routine use of NIV in patients with severe pneumonia is not recommended (Hill *et al.* 2007:[4]).

There is no compelling evidence to support the routine use of NIV in patients with severe community acquired pneumonia, but a cautious trial of NIV might be justified in some patients (Carron, Freo, Zorzi & Ori 2010:2).

- **Asthma**

Wysocki and Antonelli (2001:210) mention that the transient support of the failing respiratory system with NIV could be beneficial for patients with status asthmaticus, but that more research on the utilisation of NIV needs to be done. The utilisation of NIV in children with status asthmaticus has also proven beneficial (Noninvasive positive pressure ventilation is effective for status asthmaticus in children 2004:[1]).

Penuelas *et al.* (2007:1213) reports that the use of NIV with low inspiratory pressures in ARF secondary to status asthmaticus may be very effective in correcting gas exchange abnormalities, but larger trials are recommended to determine whether NIV has a definitive role to play in status athmaticus.

In the view of Nowak, Corbridge and Brenner (2009:S21), the use of NIV in acute asthma remains controversial and requires more research. However, exacerbations of COPD and asthma are similar leading to increased airway obstruction and impaired ventilatory efforts, causing respiratory muscle fatigue, and hence NIV should be considered as a treatment modality.

According to Gupta, Nath, Agarwal and Behera (2010:[1]), the use of NIV in addition to standard therapy for patients with severe acute asthma "… accelerates the improvement in lung function, decreases the inhaled bronchodilator requirement, and shortens the ICU and hospital stay, but a larger study is required to settle this issue".

- **Immunocompromised patients**

This specific group of patients is at high risk for developing infection-related complications owing to the suppression of the immune system. A study conducted with 40 solid organ transplant recipients showed an improvement in the PaO_2:FiO_2 ratio in 70% of the patients within the first hour of treatment. This improvement was sustained in 60% of the patients included in this trial (Wysocki & Antonelli 2001:216). Furthermore, a reduced rate of endotracheal intubation, a reduced rate of fatal complications, a shortened length of stay and a reduced mortality rate were also observed (Wysocki & Antonelli 2001:216).

The same risk-reducing benefits apply to patients admitted to CCU with ARF related to acquired immune deficiency syndrome (AIDS) when NIV is promptly introduced (Wysocki & Antonelli 2001:216). Baudouin *et al.* (2002:201) state that NIV has become standard treatment for pneumocystis pneumonia in HIV-positive patients. This is consistent with the view of Hill *et al.* (2007:[4])

Oncology patients with compromised immune systems related to chemotherapy may benefit from NIV as a result of the reduced incidence of ventilator associated infections (Piastra *et al.* 2008:831).

- **Acute lung injury**

Wysocki and Antonelli (2001:216) caution that the application of NIV for patients with acute lung injury should be limited to haemodynamically stable patients, and that intubation should not be unnecessarily delayed. L'Her, Deye, Lellouche, Taille, Demoule, Fraticelli, *et al.* (2005:1117) conclude that patients with acute lung injury can be successfully managed with NIV, and can significantly improve gas exchange by unloading respiratory muscles and relieving dyspnoea. However, L'Her *et al.* (2005:1117) comment that the appropriate ventilator settings for each patient might be difficult to establish at baseline.

Garpestad and Hill (2006:[2]) recommend that patients with acute lung injury be closely monitored when using NIV owing to the high risk of failure. Arterial blood gas values need to be monitored hourly and, if no physiological improvement in vital signs or pH is evident, the patient should be intubated without delay. In addition Hill *et al.* (2007:[4]) report that NIV should be used with caution in patients with acute lung injury owing to failure rates of 50 to 80%, resulting in patients requiring invasive ventilation.

Selected patients with mild cases of acute lung injury may be managed with NIV, but it should not be considered a first-line treatment for this group of patients owing to the high mortality rate (Yoshida, Takeda, Akada, Hongo, Tanaka & Sakamoto 2008:205). These authors recommend that patients treated with NIV should be closely monitored, and if no physiological improvement is evident after one hour of NIV, the patient should be invasively ventilated (Yoshida *et al.* 2008:205).

⇨ Social history

Group 1 stated from their clinical experience that patients who are heavy smokers do not tolerate NIV well owing to the pressure applied during NIV and the presence of the facemask which makes them feel claustrophobic. They also mentioned that patients with a history of alcohol abuse should rather be excluded from NIV, because they become aggressive as a result of withdrawal symptoms and tend to be uncooperative. Group 2 agreed with this statement, and added that medication such as anxiolytics should be considered for inclusion in order to meet the treatment goals. Groups 3 and 4 agreed with these statements.

The four groups agreed that smoking, alcohol history and recreational drug use should be listed as special considerations when deciding to commence NIV, and that these patients will need additional medication to ensure that NIV is applied properly and treatment goals are met.

The following quotations support the findings related to the social history of the patient with regard to the commencement of NIV.

"… patients that are heavy smokers and, consumes a lot of alcohol because they get a lot of Delirium Tremens …"

"… because they have DT's [Delirium Tremens]… don't, they don't do well on NIV …"

"… we agree with alcohol and drugs … because you don't want to intubate them …"

"…right we feel there if a patient's got pulmonary oedema, because they said then if you put him on non-invasive it actually increases the strain or the-the you know it actually …"

Discussion: The literature mentions the management of certain complications associated with NIV in the clinical setting (Robert & Argaud 2007:[6]). Complications which might lead to the failure of NIV include air leaks, drying of mucus membranes and aerophagia (Robert & Argaud 2007:[6]). In the view of Robert and Argaud (2007:[6]), air leaks can be managed by correctly positioning the patient in a semi-recumbent position and ensuring a proper mask fit. Issues related to drying of the mucosa, for example nasal dryness and congestion, can be resolved by including a heated humidifier which makes NIV more tolerable for the patient. Humidification is also discussed later in this chapter (see section 4.3.2.1).

Aerophagia or the swallowing of air is frequently reported by patients but is not intolerable. Robert and Argaud (2007:[6]) report that aerophagia can be limited by decreasing the peak inspiratory pressure below 25 cmH_2O. According to Hill *et al.* (2007:[7]), patient tolerance of the mask is a major predictor of the success or failure of NIV. Consequently, the mask should be a comfortable fit with minimal air leaks to enhance patient tolerance. Burns, Sinuff and Adhikari (2005:[8]) report that the use of sedatives in patients receiving NIV is not recommended as it might alter the patient's level of consciousness.

4.3.1.2 Prognosis

Groups 2 and 3 felt that the patient's prognosis is important when establishing the treatment goals for the patient. Groups 1 and 4 agreed with this statement during the brainstorming session. Following the discussion all four groups reached consensus that the treatment goals should be outlined before commencing NIV, for example the dying patient who has a do-not-resuscitate order or living will.

The following quotations support the findings related to the prognosis of the patient prior to commencing NIV.

> *"… actually now a day's whether your prognosis is good or bad, you can get non-invasive …"*
>
> *"… and also the prognosis …"*
>
> *"… even if the prognosis is bad, go for non-invasive ..."*
>
> *"… if the patient has a bad prognosis, COPD, are on home oxygen, we also commence NIV …"*

Discussion: Brochard *et al.* (2002:718) state that NIV for ARF is commenced in patients who are poor candidates for invasive ventilation owing to advanced age or do-not-resuscitate directives, by providing symptomatic relief. This is consistent with the view of Baudouin *et al.* 2002:194). The use of NIV in dying patients is still controversial. Although NIV might help to alleviate respiratory distress and ultimately prolong life for the settling of personal affairs, its commencement might also cause discomfort whilst delaying the dying process (Curtis *et al.* (2007:[1]). The goals of care need to be established and recorded before commencing NIV.

This is consistent with the view of Hill *et al.* (2007:[5]), who recommend that the goal of treatment should be in line with the wishes of the patient and the family. However, it is recommended that the patient be reassessed frequently and if

dyspnoea is not relieved, NIV should be terminated. It is the opinion of Duchateau, Beaune, Ricard-Hibon, Mantz and Juvin (2010:9) that the utilisation of NIV for palliative care or patients with do-not-intubate orders is both effective and comfortable, but the treatment goals need to be discussed and considered carefully. The goal of treatment should be directed at sustaining life during hospitalisation and avoiding intubation. Furthermore, the versatility of NIV allows for shared decision making with the patient and relatives regarding end-of-life issues (Duchateau *et al*. 2010:9).

4.3.1.3 Duration of illness

All four groups reached consensus on the issue that trauma patients are not suitable candidates for NIV due to the extreme nature of their injuries and the extended recovery period associated with traumatic injuries.

The following quotations support the findings related to the duration of illness of patients pertaining to NIV:

> *"… it's a trauma patient and a trauma patient it's going to be a long term patient then you'd rather intubated him … "*
>
> *"… also patients with brain injuries should be excluded from noninvasive …"*
>
> *"… you will not put a face mask on when they have Le forte fractures and so on but it's maybe a good thing when you have lung and chest contusions where we don't want long term ventilation …"*

Discussion: Patients with traumatic injuries are at risk for pulmonary disorders that might not be suitably managed with NIV. According to Wysocki and Antonelli (2001:215), the impaired gas exchange and the functional residual capacity cause these patients to suffer from "… traumatic wet lung …" and there is not enough evidence to support the use of NIV in these patients.

Although flail chest is most often associated with traumatic injuries related to high speed motor vehicle accidents, oncology patients with flail chest related to surgery may also benefit from NIV (Piastra et al., 2008:832). The authors agree that the use of NIV in this group of patients reduces ventilator-associated infection risks.

4.3.1.4 Inclusion criteria

Following the discussion, all four groups agreed that patients suffering from COPD need to be included in a clinical pathway for NIV. From the reflections of the participants, patients should be assessed individually before being excluded from NIV.

The following quotations support the findings related to the inclusion criteria pertaining to NIV.

> *"… patients with heart failure and myocardial infarctions which you can convert very easily…so you don't have to intubate them you can just put them on non-invasive …"*
>
> *"… patients with myocardial infarctions, congestive heart failure, asthma, COPD, and any patient that has a risk for aspiration,…gastro-intestinal distension, patients with gastro-intestinal bleeding, … who are obviously haemodynamically unstable …"*
>
> *"… is what you expect the duration of the illness will be and then the prognosis …"*

Discussion: According to Diaz, Bégin, Andresen, Prieto, Castillo, Jorquera and Lisboa (2005:1016), noninvasive ventilation has been proven effective in reducing hypercapnia and hypoxia in patients with severe COPD and ARF. In a study conducted by the same authors, it was found that, in the use of NIV for a period of three hours a day by patients with stable COPD, the $PaCO_2$ levels

decreased proportionately to an increase in PaO_2 levels which led to an increased activity tolerance at the end of treatment (Diaz et al. 2005:1018).

The patient admitted to CCU as a result of ARF, whether related to COPD or immunocompromised patients, is at greater risk for contracting nosocomial infections resulting from the invasive nature of monitoring procedures in the CCU, for example urinary catheters and endotracheal tubes (Girou, Schortgen, Delclaux, Brun-Buisson, Blot, Lefort, *et al*. 2000:2361). The avoidance of endotracheal intubation through the use of NIV has reduced the risk of contracting nosocomial infections (Girou et al. 2000:2364).

Confalonieri, Garuti, Cattaruzza, Osborn, Antonelli, Conti, Kodric, Resta, Marchese, Gregoretti and Rossi (2005:354) recommend using NIV as the first line of treatment for ARF with respiratory acidosis. Ambrosino and Vagheggini (2008:875) suggest that strong evidence exists for the management of the COPD patient with NIV, owing to improved survival rates, a reduction in the need for endotracheal intubation, a reduced complication rate and a shortened length of stay in the hospital and CCU. Khilnani and Banga (2008:356) describe NIV as "… clearly a superior alternative to standard medical therapy …".

4.3.1.5 Exclusion criteria

Groups 1, 2 and 3 agreed that certain groups of patients should be excluded from NIV owing to the risks involved in managing these patients, and that invasive ventilation is imminent for these patients. During the brainstorming session, all four groups agreed that the following patients need to be excluded from NIV:

- myocardial infarction
- congestive heart failure
- asthma – severe cases
- facial injuries and facial fractures
- facial abnormalities (due to mask leaks – ineffective)
- abdominal distension with risk of aspiration
- gastro-intestinal bleed and upper
- recent surgery to upper airway and gastro-intestinal tract

o hemodynamically unstable patients

The following quotations support the findings related to the exclusion criteria for patients pertaining to NIV.

"… we actually said the patients with myocardial infarctions, congestive heart failure, asthma, COPD, any patient that has a risk for aspiration… with gastro-intestinal distension, patients with gastro-intestinal bleeding, patients who are obviously hemodynamically unstable … and a decreased level of consciousness and patients with facial fractures …"

"… also injuries you will not put a face mask on when they have Le forte fractures …"

"… patients with heart failure and MI's …."

"… patients with facial abnormalities, not just fractures, wearing false teeth that cause leaking. And naso-gastric tubes that causes leaking, things you have to consider"

"… almost the most important thing there the patient should be hemodynamically stable… exclusion criteria, if the patient is hemodynamically unstable …"

Discussion: Contra-indications for the use of NIV exist because the safety and efficacy of NIV in these particular circumstances have not been studied or established (Brochard et al. 2002:719). In Table 4.2 the most recognised contra-indications for NIV are listed and substantiated with relevant references. Table 4.2 highlights the contra-indications for NIV found in the literature.

Table 4.2 Contra-indications for NIV

Contra-indication	References
Coma; confusion	Brochard *et al* (2002:719) Baudouin *et al. (2002:202)* Endorf *et al* (2010:217) Hill *et al.* (2007:[6]) Penuelas *et al*. (2007:1215)
Inability to protect airway	Brochard *et al* (2002:719) Baudouin *et al. (2002:202)* Endorf *et al* (2010:217) Hill *et al.* (2007:[6]) Penuelas *et al*. (2007:1215)
Severe acidosis	Brochard *et al* (2002:719) Baudouin *et al.* (2002:202)
Significant co-morbidity	Brochard *et al* (2002:719) Baudouin *et al.* (2002:202)
Vomiting; bowel obstruction; GI bleed	Brochard *et al* (2002:719) Baudouin *et al.* (2002:202) Penuelas *et al.* (2007:1215)
Recent facial, upper airway or upper GIT surgery	Baudouin *et al*(2002:202) Endorf *et al.* (2010;218) Hill *et al* (2007:[6])
Hemodynamic instability	Brochard *et al* (2002:719) Baudouin *et al. (2002:202)* Endorf *et al* (2010:217) Penuelas *et al*. (2007:1215)
Facial injuries/abnormalities	Brochard *et al* (2002:719) Baudouin *et al.* (2002:202) Endorf *et al* (2010:217) Hill *et al.*(2007:[6]) Penuelas *et al*. (2007:1215)
Facial burns	Baudouin *et al*(2002:202) Endorf *et al.* (2010:217)
Evidence of consolidation	Brochard *et al* (2002:719) Baudouin *et al.* (2002:202)

Contra-indication	References
Copious respiratory secretions	Baudouin *et al.* (2002:202) Hill *et al.* (2007:[6])
Undrained pneumothorax	Baudouin *et al.* (2002:202)
Pregnancy	Penuelas *et al.* (2007:1215)

The contra-indications for NIV found in the literature are outlined in Table 4.2. From Table 4.2, it is evident that an altered level of consciousness, inability to protect the airway, vomiting, recent surgery of the upper airway and upper GIT, hemodynamic instability and facial fractures/injuries are the most prevalent contra-indications in the literature, and should be considered as contra-indications for the use of NIV.

⇨ **Myocardial infarction**

Hill (2003:401) advises that NIV be used with caution in patients with COPD exacerbations suffering from acute myocardial infarction. In a study conducted by Crane, Elliott, Gilligan, Richards and Gray (2004:160) it was found that there was no increase in the number of myocardial infarctions in patients treated with bi-level NIV, although the peak level of creatine kinase in this group was elevated compared to a group managed with continuous positive airway pressure NIV. The authors suggest that larger studies could possibly resolve the matter due to homogeneous participant and control groups.

Winck *et al.* (2006:[15]) conclude that there is no significant increase in the risk of acute MI with the use of NIV, but the diligent monitoring of these patients is mandatory. In a meta-analysis by Peter, Moran, Phillips-Hughes, Graham and Bersten (2006:1155), it was reported that the use of bi-level ventilation in patients with acute cardiogenic pulmonary oedema had a higher incidence of myocardial infarction compared to continuous positive airway pressure NIV, and that bi-level ventilation should be used with caution.

Penuelas *et al.* (2007:1215) recommend that patients with acute coronary syndrome, cardiac arrest or cardiac arrhythmia be excluded from treatment with NIV.

⇨ **Congestive heart failure**

Patients with decompensated heart failure experience positive outcomes with NIV. Kallet and Diaz (2009:110) report that this group of patients showed a significant improvement in cardiac index, systemic oxygen delivery and oxygen consumption. The commencement of NIV reduces left ventricular pressure and thus afterload.

In view of Hill (2003:401), patients with COPD often have accompanying co-morbidities, for example CHF, and evidence exists that this group of patients benefits from NIV.

For the management of patients with congestive heart failure, Penuelas *et al.* (2007:1215) recommend using continuous positive pressure ventilation such as continuous positive airway pressure modes. Frontin *et al.* (2010:2) report similar effects when patients with congestive heart failure are treated with NIV. The use of continuous positive airway pressure in this group of patients causes a decrease in intra-pulmonary shunt and work of breathing, and simultaneously reduces left ventricular afterload and preload in both right and left ventricles.

⇨ **Asthma**

Agarwal, Malhotra and Gupta (2006:[2]) warn that the patient presenting with acute asthma may deteriorate abruptly, and that caution should be exercised when applying NIV to this group of patients. Although a trial of NIV may be justified in this group of patients, invasive ventilation should not be unnecessarily delayed. Limited data on the safety and efficacy of NIV in acute asthma is currently available. Literature pertaining to asthma has been discussed in section 4.3.1.1.

⇨ **Facial injuries, fractures and/or abnormalities**

Patient tolerance of the face mask is crucial for the success of NIV, but can cause skin injuries and discomfort (Fauroux, Lavis, Nicot, Picard, Boelle, Clément & Vazques 2005:966). The prolonged use of the face mask in children can cause facial deformities owing to the pressure of the face mask on growing facial structures (Fauroux *et al.* 2005:966).

The presence of facial injuries such as facial fractures limits the application of NIV and is considered an absolute contra-indication for the use of NIV according to Baudouin *et al.* (2002:202), Brochard *et al.* (2002:719), Hill *et al.* (2007:[6]), Penuelas *et al.* (2007:1215) and Endorf *et al.* (2010:217). Furthermore, Khilnani and Banga (2008:354) state that recent facial or upper airway trauma is considered a contra-indication for the use of NIV.

⇨ **Vomiting, abdominal distension and/or gastro-intestinal bleed**

Patients who are vomiting excessively, for example as a result of abdominal distension or GI bleed, should not be treated with NIV due to the risk of aspiration when the face mask is secured to the patient's face. This is consistent with the views of Baudouin *et al.* (2002:202), Brochard *et al.* (2002:719), Hill *et al.* (2007:[6]), Penuelas *et al.* (2007:1215) and Endorf and Dries (2010:217)

⇨ **Recent surgery to upper airway and/or gastro-intestinal tract**

Baudouin *et al.* (2002:202), Brochard *et al.* (2002:719), Hill *et al.* (2007:[6]), Penuelas *et al.* (2007:1215) and Endorf and Dries (2010:217) concur that recent surgery to the upper airway or upper GIT should be considered a contra-indication for the application of NIV owing to the risks of trauma related to the high pressures exerted during NIV.

Michelet, Blayac and Jaber (2010:454) report that the use of NIV post-operatively in patients undergoing oesophagectomy may be beneficial in preventing and correcting hypoxia. The use of NIV is not associated with anastomotic leakage, and gastric distension seems less problematic owing to the fact that inspiratory pressures can be adjusted and monitored (Michelet *et al.* 2010:458).

⇨ **Haemodynamically unstable patients**

Baudouin *et al.* (2002:202) and Brochard *et al.* (2002:719) recommend that the application of NIV in hemodynamically unstable patients be done with caution and diligent monitoring of the patient throughout. In addition, Penuelas *et al.* (2007:1215) recommend that systolic blood pressure be above 90 mmHg for the patient to be eligible for NIV.

4.3.1.6 Systems-orientated assessment

All four groups agreed that the assessment of the patient should be systems orientated and included assessment of the central nervous system, respiratory system and cardiovascular system, as seen from their reflections. Some of the groups included the interpretation of diagnostic tests as being relevant.

The following quotations support the findings related to the systems-orientated assessment of the patient pertaining to NIV.

"… we did the assessment systematically like they did …"

"… can we go through all the systems …"

⇨ Central nervous system

The four groups agreed that the patient's level of consciousness needs to be assessed prior to commencing NIV. The Glasgow Coma Scale (GCS) should be calculated first and should range between 13 to 15 out of 15, according to Groups 1,2 and 4. Group 3 stated that the GCS should not be used as the only parameter to judge the patient's level of consciousness; instead the patient should be able to comprehend what is happening and what the procedure entails (see Annexure C2).

Consensus was reached that the patient should be awake and cooperative, irrespective of the GCS, and should be able to understand the procedure when explained to him. Group 4 coined the phrase "… awake and willing…" in other words, the patient should be awake and able to understand the procedure and willing to undergo the procedure.

The following quotations support the findings related to the assessment of the central nervous system of the patient pertaining to NIV.

"… the Glasgow Coma Scale (GCS), because a patient with a GCS of 14 can be combative sometimes, so we decided to include level of consciousness. He should be awake and comprehend what is going to happen …"

"… a GCS of 14 and 15 absolutely qualifies for NIV …"

"… assess the patient's level of consciousness…so at least he will co-operate …"

"… to assess the underlying mental status, so make sure that they are not too confused or aggressive because then they also don't co-operate and they take off the mask … sedation status, that they are not too sedated …"

Discussion: Coma and confusion, along with an inability to protect the airway, are considered as absolute contra-indications for the application of NIV (Baudouin *et al*. 2002:202). This is consistent with the views of Brochard *et al*. (2002:719), Hill *et al*. (2007:[6]), Penuelas *et al*. (2007:1215) and Endorf and Dries (2010:217).

Scarpazza *et al*. (2008:797) conclude that the risk of aspiration pneumonia is associated with the use of NIV in patients with an altered level of consciousness, and that caution be exercised in such cases. In the same study, the authors concluded that the GCS should be considered as an important parameter for the success of NIV, and should range between 11 and 15/15 (Scarpazza *et al*. 2008:799). Furthermore, Ambrosino and Vagheggini (2008:875) suggest that severe encephalopathy should be considered a contra-indication for the use of NIV. The patient is predisposed to aspiration as a result of depression of the sensorium. In contrast, Khilnani and Banga (2008:354) state that NIV can be successfully applied in patients with hypercapnic coma, and that the scope of NIV usage is constantly being widened.

⇨ **Respiratory system**

All four groups discussed the data needed to be included in the assessment of the respiratory system, and all groups mentioned the parameters that they deemed important when assessing the respiratory system (see Annexure C2).

The groups reached consensus on the following parameters:

- respiratory rate < 30 per minute
- utilisation of accessory muscles
- arterial blood gas values should be assessed at baseline
- observe for signs of severe respiratory distress that necessitates invasive ventilation
- auscultate the lungs bilaterally for air entry
- observe for cyanosis – peripheral and central
- observe secretions – amount and colour as part of diagnosis

Group 3 suggested making use of "… look, listen, feel…" when assessing the respiratory system for abnormalities, in other words, inspection, auscultation and percussion (see Annexure C2).

The following quotations support the findings related to the assessment of the respiratory system of the patient pertaining to NIV.

"… important to assess the patients respiratory rate … preferably up to about 30, maybe 35 … Also assess for the use of any accessory muscles. "

"… monitor the arterial blood gas values, also the respiratory rate and accessory muscle use …"

"… obviously the x-ray can have valuable information …

"… according to inspection, percussion, palpitation …"

Discussion: Diaz et al (2005:1020) found that the relief of dyspnoea in COPD patients is a good indicator of the success of NIV, as this is directly related to the

breathing rate of the patient. The relief of dyspnoea slows the breathing rate which promotes lung deflation. Furthermore, Scapazza *et al*. (2008:798) state that the average respiration rate of the study participants prior to the commencement of NIV ranged between 31 and 39 breaths per minute.

Ambrosino *et al*. (2008:874) conclude that NIV reduces the work of breathing by allowing the respiratory muscles to rest, thus relieving dyspnoea. This leads to an improvement in arterial oxygenation, hypercapnia and related respiratory acidosis. The work of breathing can be uniformly decreased with the commencement of NIV, owing to the reduction in mean airway pressure (Kallet & Diaz 2009:104).

⇨ **Cardiovascular system**

The hemodynamic stability of the patient is part of the assessment to predict the suitability of the patient for NIV, as seen from the reflections of all four groups.

The following quotations support the findings related to the assessment of the cardiovascular system of the patient pertaining to NIV.

> *"… the patient should be hemodynamically stable, specifically pertaining to the blood pressure and the heart rate …"*
>
> *"… to exclude patients with heart failure and myocardial infarctions …"*
>
> *"… we have nothing to add since you've covered everything …"*

Groups 1, 2 and 3 agreed that assessment of the cardiovascular system needs to be considered as part of the baseline data that should be gathered prior to commencing NIV. During the brainstorming session the participants in Group 4 supported this statement. The baseline values of the following parameters should be included:

- heart rate and rhythm
- blood pressure

Group 1 suggested that a haemoglobin level above 8 g/dl is essential for the success of NIV – haemoglobin levels of less than 8g/dl will impair oxygen carrying capacity. Group 1 indicated that optimal fluid status is important. Group 2 suggested that specific conditions such as cardiac tamponade, cardiac effusions and myocardial infarction (MI) should be excluded from management with NIV.

All four groups reached consensus that the patient needs to be haemodynamically stable, with all parameters within normal ranges to be considered for management with NIV, and that patients suffering from acute myocardial infarction should be excluded (see Annexure C2).

Discussion: Wysocki and Antonelli (2001:213) explain that the reduction in preload resulting from the effects of NIV in the failing left ventricle can be beneficial to left ventricular output by reducing venous return. As suggested by Kallet and Diaz (2009:103), the application of NIV has certain negative effects on the cardiovascular system. Subsequently, venous return is reduced, which leads to a decrease in cardiac output and systemic hypoperfusion. Furthermore, Penuelas *et al.* (2007:1215) recommend that the systolic blood pressure be above 90 mmHg for the patient to be eligible for NIV.

Cardiac instability, including shock, ventricular dysrhythmias and complicated myocardial infarction, should be considered as absolute contra-indications for the use of NIV (Soo Hoo 2010:[3]). If the systolic blood pressure decreases below 90 mmHg the patient should rather be considered for **invasive** ventilation (Soo Hoo 2010:[15]).

⇨ **Diagnostic test**

This section depicts the diagnostic tests that all four groups deemed important as part of the assessment of the patient for NIV upon admission to CCU (see Annexure C2 and C6).

This section includes the following:

- chest x-ray evaluation
- arterial blood gas (ABG)
- additional blood tests

- o infection markers (white cell count, c-reactive protein, procalcitonin)
- o routine blood tests requested in CCU
- o 12- lead electrocardiogram (ECG)

The following quotations support the findings related to the relevant diagnostic tests for the patient.

"… baseline arterial blood gas, chest x-rays, vital signs, all of that need to be assessed …"

"… two hourly or four hourly after the initiation of the non-invasive ventilation to see whether your patient is progressing …"

"… investigations at baseline include chest x-rays, bloods, arterial blood gas and ECGs (electrocardiogram) …"

"… we also said the x-rays [chest x-rays]… we also said about the blood gases [arterial blood gasses]…"

- **Chest x-ray**

The four groups agreed that a baseline chest x-ray needed to be done prior to the commencement of NIV in order to establish or confirm the diagnosis. The chest x-ray should be repeated daily to assess whether there is any improvement or changes, and whether the patient should be taken off the clinical pathway for NIV. The chest x-ray will aid in clinical decision making regarding continuation with NIV or whether the patient should be invasively ventilated.

Discussion: Brochard *et al.* (2002:719) advise that the patient's chest x-ray be assessed prior to commencing NIV for signs of consolidation. In the presence of consolidation, the patient should be excluded from treatment with NIV. This is consistent with the view of Baudouin *et al.* (2002:202), who note that NIV has been successfully used in patients with pneumothorax, providing an intercostal drain is inserted prior to commencing NIV. In addition, Penuelas *et al.*

(2007:1215) advise that the presence of pneumothorax should exclude the patient from treatment with NIV owing to increased risk of trauma to the lungs.

- **Arterial blood gas (ABG)**

All four groups agreed that the determination of ABG values at the baseline will be of great value when deciding on the appropriate management of the patient presenting with ARF. The specific ABG parameters to assess include the pH level, oxygenation status and ventilation status. The metabolic status should also be assessed to look for other causes of ARF. The ABG should then be assessed at regular intervals, for example every two hours.

Discussion: Wysocki and Antonelli (2001:210) conclude that in patients with a $PaCO_2$ value, ranging between 58 and 66 mmHG, the application of NIV can successfully reverse hypoxia. It is the opinion of Baudouin *et al.* (2002:203) that the patient managed with NIV should be monitored at regular intervals. Analysis of ABG values should be done at baseline and again re-assessed after one hour of treatment. The intervals for re-assessment should then be dictated by the patient's condition and response to treatment.

Penuelas *et al.* (2007:1215) recommend that the following criteria be met with regard to ABG values for the patient to be eligible for NIV:

- pH <7.35
- $PaCO_2$ >50 mmHg
- PaO_2 <60 mmHg at room air (FiO_2 21%) or
- PaO_2 : FiO_2 ratio <200.

The assessment of the patient should be ongoing and arterial blood gas values assessed after one to two hours of NIV (Penuelas *et al.* 2007:1215; Soo Hoo 2010:[13]). Hill *et al.* (2002:[8]) suggest repeating the arterial blood gas at one to two hours after commencing NIV, and the continuous monitoring of pulse oximetry values.

- **Infection markers and routine blood tests**

The blood tests to be included in the assessment of the patient include a sepsis marker, namely C-Reactive Protein (CRP), Pro-calcitonin (PCT), which the groups

agreed would be beneficial in determining the patient's diagnosis and prognosis. Other valuable tests to consider include the haemoglobin levels (Hb) and white cell count (WCC) which are routinely included in a full blood count (FBC). The electrolyte levels, including calcium, magnesium and phosphate, should also be assessed to determine other underlying pathology, for example acidosis related to renal failure, which will also be evident from the urea and creatinine levels (UKE). The serum levels of cardiac enzymes should be determined in order to assist with the diagnosis of myocardial infarction, which the groups agreed should be excluded from treatment with NIV.

Discussion: The routine monitoring of the patient described in the literature does not include pathology tests as described above. The literature does however focus on the specific arterial blood gas values including pH, $PaCO_2$ and PaO_2 as discussed in Section 4.3.1.6.

4.3.2 Theme 2: Planning

The data obtained from the individual groups during the brainstorming session are summarised in Annexure C3. The data on which consensus was reached following discussion and feedback from the participants are summarised in Table 4.1 (also see Annexure C6). The research findings were based on the group discussion and feedback (see Annexure C2 and C6). A discussion of the research findings follows in sections 4.3.2.1 to 4.3.2.4. Phase 1 and Phase 2 will be discussed concomitantly as mentioned in section 4.2.

The researcher posed the following question regarding planning for the commencement of NIV for the patient presenting with ARF.

*What should be included in **planning** for the commencement of NIV for the patient presenting with ARF?*

The question posed to the participants required them to write down what they thought was important when planning for the commencement of NIV.

The following section provides a summary of the data collected from the individual groups as well as a summary of the data on which consensus was reached during the brainstorming session, as seen in Annexures C3 and C6.

4.3.2.1 Equipment

All four groups indicated that different hospital groups make use of different suppliers and different makes and models of ventilators and equipment. Groups 1, 2, and 4 stated that humidification is important and should be included. Group 2 also included establishing an intravenous access (IV line) as important for the administration of emergency medication. Group 3 supported the statement during the brainstorming session. Consensus was reached that the equipment used must be capable of delivering NIV and that the clinical pathway should include the specific equipment used in the CCU where it will be implemented.

The following quotations support the findings related to the planning for the commencement of NIV pertaining to equipment needs.

"… have a noninvasive ventilator in place because not all ventilators can do non-invasive …"

"… also the type of mask that you are going to use…as far as I know there's three types of masks on the market…"

"…you need … a mask…a humidifier…"

"…so I just think it depends on your hospital what do you start with …"

"… which one will be mostly available to you …"

Discussion: Owing to the fact that different hospitals make use of different suppliers, makes and models of ventilator equipment, the researcher deemed it unnecessary to discuss the masks and ventilators used in this section. The specific equipment used in the hospital is mentioned in the clinical pathway and care document (see Annexure E1).

The presence of air leaks and the unidirectional flow of air during NIV results in drying of the nasal mucosa. This increases airway resistance leading to mouth breathing causing more air leaks, but the use of heated humidification significantly increases relative humidity in the airways reducing airway resistance and enhancing patient comfort (Schönhofer & Sortor-Leger 2002:1034).

During NIV the upper airway is not bypassed as with invasive ventilation, but the risk of drying out the mucus membranes of the upper airway exists, owing to the high flow delivered to the patient (Kallet & Diaz 2009:108). The use of humidification is therefore advised. The selection of the humidification device should not negatively impact on the treatment goals. In addition, the use of a heated humidifier is preferable over a heat-and-moisture exchange (HME) device, which is associated with an increase in the work of breathing (Kallet & Diaz 2009:109).

Humidification during NIV remains controversial, as there is very little data available on the subject, as stated by Branson and Gentile (2010:214). The use of a heated humidifier is preferable over that of a heat-moisture-exchange device. The authors are of the opinion that the heat-moisture-exchange device adds to the dead space, which increases the work of breathing (Branson & Gentile 2010:214).

In addition to the high flow of air, medical gases supplied from a pipeline or cylinder are much drier than ambient air, which further depletes the mucosa of moisture, and thus reducing cilliary activity in the airways, leading to functional alterations of the epithelium (Chiumello, Chierichetti, Tallarini, Cozzi, Cressoni, Polli, Colombo, Castelli, & Gattinoni 2008:[5]). Chiumello *et al*. (2008:[5]) are of the opinion that medical gases should more closely mimic atmospheric air, and therefore heated humidification is necessary when applying NIV. The use of a

heated humidifier is reported to enhance patient comfort, which ensures patient tolerance of NIV (Branson & Gentile 2010:211). Furthermore, Schönhofer and Sorter-Leger (2002:1035) conclude that training should be available to deal with equipment issues surrounding NIV.

4.3.2.2 Patient safety

Patient safety when applying NIV is an important consideration. The specific aspects addressed by the participants are evident from their reflections. All four groups agreed that patient safety should be included as relevant for the success of NIV.

The following quotations support the findings related to the planning for the commencement of NIV pertaining to patient safety.

> *"… the knowledge of the person or the skills that is needed …"*
>
> *"… That's what I mean … the critical care environment, ICU or high care but not the wards …"*
>
> *"… staff ratio should be one to one …"*
>
> *"… rated as a high care patient where they are much more labour intensive than a sedated paralysed patient. So they are very-very labour intensive."*
>
> *"You have to hold their hand, comfort them, speak to them …"*
>
> *"So they should be a one to one ratio*."

Groups 3 and 4 mentioned patient safety as an important part of the planning process. They felt that the nurse practitioner responsible for the management of the patient receiving NIV should be knowledgeable and skilled in the management of NIV. Group 4 also maintained that the added workload

associated with NIV necessitates a staffing ratio of one nurse practitioner to one patient. During discussion, Groups 1and 2 supported this statement.

Discussion: Wysocki and Antonelli (2001:216) conclude that the patient with ARF should be managed with expertise, owing to the life-threatening nature of hypoxemia. Abrosino and Vagheggini (2008:875) state that NIV can be safely applied to the hypoxemic patient by an experienced practitioner. Manuel, Russell and Jones (2010:55) agree that detailed observation of the patient is essential, and NIV should be administered in a CCU. Agarwal *et al.* (2005:641) conclude that although NIV is time consuming, it remains more cost-effective when compared with invasive ventilation. NIV is a safe and effective treatment for patients presenting with ARF resulting from COPD when operated by well-trained teams (Confalonieri *et al.* 2005:348).

The success of NIV relies on several factors, but the experience of the multidisciplinary team is vital to the correct management of the patient in order to achieve treatment goals (Nava, Navalesi & Conti 2006:361; Soo Hoo 2010:[4]). In addition, Penuelas *et al.* (2007:1212; Soo Hoo 2010:[5]) advise that the patient receiving NIV should be admitted to a unit where a high level of monitoring is possible, and where staff are skilled in airway management. In contrast, Ambrosino and Vagheggini (2008:874) and Soo Hoo (2010:[22]) conclude that the cost of NIV is less than that of invasive ventilation, because additional staffing is not required.

Antonelli, Conti, Esquinas, Montini, Maggiore, Bello, Rocco, Maviglia, Pennisi, Gozalez-Diaz and Meduri (2007:22) note that patients receiving NIV should be closely monitored in the CCU setting. If NIV is applied by expert clinicians, 50% of patients presenting with ARF avoid endotracheal intubation (Antonelli *et al.* 2007:22).

4.3.2.3 Ventilator settings

The specific therapeutic ventilator settings have not yet been established. The data collected from the groups during the brainstorming session pertaining to ventilator settings are summarised in Annexure C3.

The following quotations support the findings related to the planning for the commencement of NIV pertaining to ventilator settings.

"… we said there it is also patient specific …"

"… so you will state the ventilator, state the settings, state the alarms. the PEEP [postivie end-expiratory pressure], the pressure support, the sensitivity the Peak flow, amend the alarm specifically for that patient …"

"… I think what I've discovered now; some people start off with a high PEEP and high pressure support … so start them on a low PEEP and a low pressure support …"

"… And look at the patient specific …"

"… they normally say that you should start on a 100% oxygen, we felt that actually maybe we shouldn't …"

From the reflections of the four groups it is evident that ventilator settings should be patient specific. Groups 1 and 4 disagreed on the percentage of oxygen delivery at the onset of NIV. Groups 1, 2 and 4 agreed that the specific settings for oxygen delivery, PEEP, and pressure support should be patient specific according to the patient's response and how well the patient is able to tolerate NIV, in order for the intervention to be successful. All four groups then agreed and consensus was reached that the setting should be patient specific and continuous monitoring of the patient is essential.

Discussion: Wysocki and Antonelli (2001:217) state that one ventilatory mode could not be recommended over another, but evidence exists that pressure support modes are most frequently used.

In a study comparing BiPAP with conventional medical therapy, Agarwal *et al.* (2005:640) found that BiPAP is more effective at unloading respiratory muscles than continuous positive airway pressure (CPAP) alone in patients with COPD and

acute cardiogenic pulmonary oedema, and that gas exchange is rapidly improved during BiPAP.

Khilnani and Banga (2008:352) agree that pressure-cycled positive pressure ventilation is the most appropriate mode for NIV, and add that the CCU with limited NIV experience should opt for bi-level positive airway pressure modes (BiPAP). During BiPAP, positive airway pressure can be applied during inspiration as well as expiration at a preset pressure (Khilnani & Banga 2008:352). In addition, Ho and Wong (2006:[6]) found that BiPAP is more effective at reducing the work of breathing in patients with acute cardiogenic pulmonary oedema than CPAP, because the level of airway pressure applied can be titrated according to the patient's needs without excessive reductions in cardiac output.

Prinianakis, Delmastro, Carlucci, Ceriana and Nava (2004:314) conducted a study to determine the effects of pressurisation rates during NIV. The authors concluded that initial lower settings during initiation of NIV cause an increase in the work of breathing and increased patient effort. A quick pressurisation rate had more favourable effects by reducing patient effort; however, the higher pressurisation rates caused significant air leaks leading to poor patient tolerance (Prinianakis *et al.* 2004:316)

Agarwal *et al.* (2005:641) suggest that the initial pressure settings should be low in order to gain the patient's confidence and cooperation. The authors suggest holding the mask in place instead of strapping it to the patient's face immediately, to reduce the chances of intolerance. According to Agarwal *et al.* (2005:641) and Soo Hoo (2010:[13]), pressures should be gradually increased to reach the patient goals for improved gas exchange, but should not exceed 20-25 cmH_2O to minimise the risk of gastric inflation and vomiting.

The stepwise application of pressure support in increments of 5cmH_2O progressively reduces airway pressure, thereby reducing the work of breathing (Kallet & Diaz 2009:105). Positive pressure ventilation is more beneficial in reducing respiratory workload, but asynchrony between patient and ventilator may cause deterioration of gas exchange (Diaz-Lobato, Alises & Rodriguez 2006:129).

Both NIV modes, continuous positive airway pressure and bi-level positive airway pressure, are effective in reducing the need for invasive ventilation, but one mode is not superior over the other according to Weng, Zhao, Liu, Fu, Sun, Ma, Chen and He (2010:599). However, the use of NIV does not reduce the incidence of myocardial infarction associated with acute cardiogenic pulmonary oedema (Weng *et al.*2010:599).

In order to facilitate patient comfort and tolerance of the face mask, moderated levels of pressure should be applied when initiating NIV (Michelet *et al.* 2010:459). Pressure support should be commenced at 10cmH_2O, as higher pressures are associated with air leaks causing discomfort and leading to poor tolerance of the face mask (Michelet *et al.* 2010:459).

Aspects pertaining to humidification have been discussed in section 4.3.2.1.

4.3.2.4 Patient monitoring

In section 4.3.2.4 the continuous monitoring of the patient who will be treated with NIV is discussed. This section includes information regarding the haemodynamic monitoring of the patient, as discussed by the four groups during the brainstorming session (see Annexure C3).

The following quotations support the findings related to the planning for the commencement of NIV pertaining to patient monitoring.

"… the timeframe in planning as well because you want certain outcomes at the end of the day… and it must be patient specific …"

"… and then positioning your patient … is he sitting in the chair, is he sitting in bed … plan according to your specific outcomes …"

"… blood gases [arterial blood gases] four hourly or two hourly …."

"… haemodynamic evaluation and a systematic review … to see if what you found there is better or not …"

"… plan risk factor management … prevent the patient from getting pressure sores, prevent it, you not wait till it happens …"

From the reflections of the participants it is clear that all four groups concurred that continuous monitoring of all the systems is vital. Haemodynamic monitoring should be done at least hourly, as well as monitoring of the respiratory system, including the tidal volume, air entry and peripheral saturation (SpO_2).

Group 3 also included a time frame for the management of the patient, and suggested that there should be a specific time frame for establishing whether the patient is improving or whether the patient should be invasively ventilated. Groups 2 and 3 added that the patient should be assessed for risk factors such as the development of pressure sores related to the mask fit. Group 4 also stated that the patient should be nursed in a semi-fowlers position to enhance patient comfort and improve lung expansion.

Consensus was reached that the monitoring of arterial blood gas values needs to be done at least four hourly or according to the specific patient's needs. Haemodynamic monitoring should be done at least hourly and should include ventilator settings. Risk factors such as the development of pressure sores related to mask fit should be continuously assessed and prevented. The positioning of the patient in a semi-fowlers position might be beneficial to enhance lung expansion.

The continuous monitoring of the patient receiving NIV is essential. The following discussion deals with the hemodynamic monitoring of the patient, the intervals for arterial blood gas monitoring and the risk factors associated with NIV.

⇨ Haemodynamic monitoring

Penuelas *et al.* (2007:1212) advise that the patient receiving NIV should be admitted to a unit where a high level of monitoring is possible, and where staff are skilled in airway management. It is furthermore recommended that the patient should be monitored every five minutes, including heart rate, blood pressure, respiration rate, oxygen saturation and clinical status, until the patient is found to be stable (Penuelas *et al.* 2007:1215). Patients should be closely monitored, and if the respiration rate remains above 25 breaths per minute with no physiological improvement in gas exchange, the patient should be **invasively** ventilated (Yoshida *et al.* 2008:201).

Frontin *et al.* (2010:6) suggest that the management of patients with NIV is preferable in the acute care setting, owing to the fact that pharmacological interventions may be needed to achieve treatment goals.

⇨ Arterial blood gas

Table 4.3 depicts the data collected from a study to assess the risk of NIV failure in patients with COPD (Confalonieri *et al.* 2005:350).

Table 4.3 Parameters of patients who succeeded on NIV

Parameters	Findings
Age	> 69 years
GCS	13–15/15
ABG values on admission:	
PaO_2	> 54 mmHg
$PaCO_2$	> 78 mmHg
pH	> 7.29
RR	> 28
PaO_2/FiO_2	> 189
ABG values after 2 hours	
PaO_2	> 63 mmHg
$PaCO_2$	> 69 mmHg
pH	> 7.34

Adopted from Confalonieri et al. (2005:350)

From Table 4.3 it is evident that the patients who succeeded on NIV showed marked physiological improvements after two hours. Carron *et al.* (2010:5) recommend monitoring the oxygenation of the patient. If there is no improvement in the oxygenation after one hour of NIV, it is likely that the patient will fail NIV, and should be invasively ventilated as soon as possible.

⇨ **Patient comfort and risk factors**

Diaz-Lobato *et al*. (2006:131) suggest that the following aspects are important with regard to the basic monitoring of a patient receiving NIV, as depicted by Diaz-Lobato *et al*. (2006:131) include:

- patient comfort
- mask fit and sealed
- NIV timeframe
- problems with adaptation (nasal congestion, dryness of mucous membranes, gastric insufflation, conjunctival irritation, inability to sleep)
- symptoms (dyspnoea, fatigue, headache, hyersomnolence)
- gas exchange (nocturnal oximetry, arterial blood gas measurement periodically to assess $PaCO_2$)

Khilnani and Banga (2008:352) suggest that the patient be placed in a reclining position of at least 45° to promote comfort. The authors recommend that a well-fitting mask be used and that the patient be familiarised with the mask prior to commencing NIV. The mask should be held in place and ventilation commenced. Once patient comfort and synchrony are ensured, the mask can be secured with the straps provided. Robert and Argaud (2007:[6]) suggest that placing the patient in a semi-recumbent position enhances patient comfort and minimises air leaks leading to improved patient tolerance of NIV. This is consistent with the view of Antonelli *et al.* (2007:19).

Risk factors associated with NIV include the formation of pressure ulcers owing to focal skin irritation related to pressure exerted by the mask (Endorf & Dries 2010:225). These complications can be prophylactically managed in the clinical setting by ensuring that head straps are not excessively tight causing pressure. A typical site of pressure ulcer formation is the bridge of the nose (Endorf & Dries 2010:225). Carron *et al.* (2010:2) describe NIV as a mode of ventilation which

preserves protective airway mechanisms, speech and swallowing, thus improving patient comfort.

4.3.3 Theme 3: Implementation

The data obtained from the individual groups during the brainstorming session are summarised in Annexure C4. The data on which consensus was reached following discussion and feedback from the participants are summarised in Table 4.1 (also see Annexure C6.)

The research findings were based on the group discussion and feedback (see Annexures C4 and C6). A discussion of the research findings follows in sections 4.3.3.1 to 4.3.3.2. Phase 1 and Phase 2 will be discussed concomitantly as mentioned in section 4.2.

The researcher posed the following question regarding implementation of NIV for the patient presenting with ARF. The four groups were asked to discuss and write down their thoughts pertaining to the implementation of NIV for the patient presenting with ARF. This section provides a summary of the data collected during the brainstorming session (see Annexure C4).

The following question was posed to the groups:

*How would you **implement** NIV for the patient presenting with ARF?*

*What data should be taken into account when deciding to **implement** NIV?*

The following section provides a summary of the data collected from the individual groups as well as a summary of the data on which consensus was reached during the brainstorming session, as seen in Annexures C4 and C6.

4.3.3.1 Holistic patient care

The conceptual framework for this study was the nursing process. The steps in the nursing process indicate the sequence of events that ensure that nursing care is not fragmented but carried out holistically to ensure enhanced patient outcomes (as discussed in Chapter 1 – see section 1.6.4).

⇨ Patient communication and information

This section contains information regarding the holistic patient care approach as indicated by the nursing process (Suddarth 1991:5; Quan 2007:[1]).

The following quotations support the findings related to the implementation of NIV pertaining to continuous communication and information.

"… to get consent from the patient as well as the family…if you have a calm enough patient…"

"… we [hospital] have to obtain consent…but with consent of the family and the patient…that's included …"

"…these patients [on NIV] are a lot of work … you have to hold their hand, comfort them, speak to them ..."

"… what was important to us [nurse practitioners] is the continuous communication and education of the family members plus the patient himself …"

"… spiritual needs, like a pastor or reverend… or whoever and …"

"… keep your patient calm and reassure him … as well as the family…"

"…yes, so we [nurse practitioners] look at the package [holistic]… instead of just looking at components ..."

As seen from the reflections, all four groups mentioned the importance of continuous communication and education of the patient with regards to NIV. All four groups stated that the potential benefits and risks should be explained to the patient, and that the relatives should be included in order to facilitate a better understanding of the procedure, and possibly improving patient outcomes.

Consensus was reached on the issue that continuous communication and education/information should be provided in an effort to improve patient compliance and potentially improve the outcome.

Discussion: Ambrosino and Vagheggini (2008:874) suggest that NIV is a more acceptable treatment modality owing to the reduced risks associated with NIV. Patient comfort is also enhanced owing to the fact that there is a reduced need for sedation, which means that the patient is able to eat, drink and communicate. Adequate physiotherapy can be applied without any of the restrictions that result from invasive ventilation (Ambrosino *et al.* 2008:874).

Metha and Hill (2001:542) state that NIV is a comfortable alternative to endotracheal intubation, because the patient does not have to endure the discomfort of regular endotracheal suctioning. The patient managed with NIV is also able to communicate with nurse practitioners and relatives, thereby reducing feelings of isolation and powerlessness.

The patient is also able to continue normal oral intake of food, fluids and medication, thereby reducing the incidence of gastro-intestinal adverse effects (Sprague *et al.* 2000:[8]; Metha & Hill 2001:542). This is consistent with the views of Endorf and Dries (2010:217).

⇨ **Spiritual needs**

Addressing the spiritual needs of the patient as part of a holistic patient care approach is part of the nurse practitioner's responsibilities as outlined in the Scope of Practice (R2598) and forms part of the daily duties of the nurse practitioner charged with caring for the patient, according to South African Nursing Council regulations.

The Scope of Practice of the Professional nurse states: "… the provision of effective patient advocacy to enable the patient to obtain the healthcare he needs …". This includes attending to the spiritual needs of the patient by allowing visits from spiritual leaders, should the patient request it.

Failing to provide for the spiritual needs of the patient is failing to abide by the regulations of nursing practice as stated in Regulation 387 (Acts and Omissions) "… wilful or negligent omission to carry out such acts in respect of diagnosing, treatment, care, prescribing, collaborating, referral, coordinating and patient advocacy as the scope of his profession permits (sic.) …".

4.3.3.2 Initiation of noninvasive ventilation

The essential patient care to be rendered during the initiation of NIV, as suggested by the groups during the brainstorming session, is summarised in Annexure C4.

The following quotations support the findings related to the implementation of NIV pertaining to patient care.

> "… *I also say our implementation and planning phase is overlapping with some of the other groups …"*
>
> *"… now this can be implementation or planning …"*
>
> *"… but like I say some of the things are overlapping …"*

Consensus was reached that some of the information included in this phase overlaps with the planning phase. The groups concurred that this phase should therefore be referred to as the "Initiation phase" in the draft clinical pathway.

Obtaining informed consent from the patient/relatives for commencing NIV was included as part of the initiation phase, in an effort to enhance patient

compliance with the intervention. Baseline data should be established before commencing NIV.

The correct equipment as described in Section 4.3.2.1 needs to be assembled, and the ventilator prepared according to the specific patient needs. Ventilator alarm settings were included to prevent lung injuries and ensure patient safety. All the groups concurred that the staffing ratio should then be 1:1 ensure high quality patient care and safety.

Discussion: The specific patient care relevant to the patient receiving NIV will be discussed in the following section, and includes establishing baseline data, correct positioning of the patient, assembling the correct equipment, knowledge of the staff regarding NIV, preparation of the ventilator for NIV, alarm settings and patient safety(Soo Hoo 2010:[13]). Owing to the overlapping nature of the content with the planning phase, the data have not been duplicated in this section. Reference is made to the applicable section for the in-depth discussion.

⇨ **Patient care**

The specific patient care for the patient receiving NIV includes routine nursing care and observations including vital data and the assessment of risk factors. The patient should therefore be in a CCU setting where diligent monitoring of the patient is possible (Soo Hoo 2010:[5]).The assessment of risk factors such as pressure sores and skin breakdown due to the pressure of the mask should be done frequently and prophylactic actions taken (Soo Hoo 2010:[11]).

- **Establish baseline data**

The physical assessment of the patient and the arterial blood gas (ABG) analysis should be repeated after one hour of treatment (Hill 2007:[8];Khilnani & Banga 2008:352: Soo Hoo 2010:[13]).

- **Correct positioning**

Khilnani and Banga (2008:352) suggest that the patient be in a reclining position of at least 45° to promote comfort. The authors recommend that a well-fitting mask be used and that the patient be familiarised with the mask prior to commencing NIV. The mask should be held in place when ventilation

commences. Once patient comfort and synchrony are assured, the mask can be secured with the straps provided.

- **Assemble equipment**

The assembly of the correct equipment needed for NIV has been discussed in section 4.3.2.1.

- **Ensure knowledgeable staff**

The education and training of staff has been discussed in section 4.3.2.2.

- **Prepare the ventilator**

Data related to the preparation of the ventilator and the specific settings for NIV have been discussed in section 4.3.2.3.

- **Setting alarms and patient safety**

Matters related to alarm settings to ensure patient safety during NIV have been discussed in sections 4.3.2.2 and 4.3.2.3.

⇨ **Multidisciplinary team approach**

The aim of the study was to collaboratively develop a clinical pathway for NIV by involving members of the multidisciplinary team. The success of the clinical pathway depends on the collaborative efforts of the multidisciplinary team to improve patient outcomes. The benefits of successful clinical pathway implementation are discussed in section 2.4.2.

The following quotations support the findings related to the implementation of NIV pertaining to the multidisciplinary team approach

"… then the multidisciplinary team is very important …"

"… physiotherapist, the dietician, the nurse, the doctor, the pharmacist, the radiologist, the laboratories …"

"… the physio, … and also here we actually said what that group said …"

It is evident from the reflections and from the feedback of all four groups that the multidisciplinary approach is vital. Consensus was reached among the four groups that the successful implementation of NIV requires a multidisciplinary team approach, which includes the physician, physiotherapist, nurse practitioner and dietician. Collaborative efforts have the potential to enhance patient outcomes. The nurse practitioner responsible for this patient should be knowledgeable and competent in caring for the patient receiving NIV.

Discussion: The roles of the members of the multidisciplinary team will be discussed in the following section. The literature makes specific reference to the following members, namely physiotherapists, physicians, nurse practitioners and radiographers.

- **Physiotherapists**

MacIntyre and Huang (2008:534) suggest that the use of additional therapies such as physiotherapy and pharmacological therapy in conjunction with NIV might be beneficial to selected patients with COPD exacerbations, but acute lung injury should be avoided. Ambrosino and Vagheggi (2008:874) suggest that the use of NIV does not impair the application of adequate physiotherapy.

- **Physicians**

Agarwal *et al.* (2005:641) suggest that the physician prescribing NIV should personally commence NIV before prescribing a preset pressure level in order to assess the patient's tolerance for the device.

- **Nurse practitioners**

The competency of the nurse practitioner responsible for the management of the patient receiving NIV has been discussed in section 4.3.2.2.

- **Radiographers**

The criteria for chest x-rays have been discussed in section 4.3.1.6.

- **Spiritual counsellor**

The spiritual needs of the patient have been discussed in section 4.3.3.1.

⇨ **Specific observations**

This phase is labelled the "initiation phase", meaning that this is when NIV is actually applied to the patient and the specific observations that need to be done in order to ensure correct management of the patient.

The following quotations support the findings related to the implementation of NIV and pertaining to the commencement of NIV.

"… you [nurse practitioner] evaluate right through…not just at the end…that's why it includes things like blood gasses [arterial blood gases] and chest x-rays …"

"… we [group] said haemodynamic evaluation and systematic review …"

"… since we [nurse practitioners] assess systematically we [nurse practitioners] should review systematically and at the end just to see if what you [nurse practitioner] found there is better or not …"

From the reflections of the participants it is clear that a systematic process of evaluation of the success of NIV should be done. Consensus was reached among the four groups that the correct equipment should be assembled and the mask fitted to the patient to ensure effective NIV. Patient monitoring should be done hourly and arterial blood gas parameters monitored according to patient needs.

Discussion: The relevant data have been discussed in sections 4.3.2.1, 4.3.2.3 and 4.3.2.4.

4.3.4 Theme 4: Evaluation

The data obtained from the individual groups during the brainstorming session are summarised in Annexure C5. The data on which consensus was reached following discussion and feedback from the participants is summarised in Table 4.1 (also see Annexure C6).

The research findings were based on the group discussion and feedback (see Annexures C5 and C6). A discussion of the research findings follows in section 4.3.4. Phase 1 and Phase 2 will be discussed concomitantly as mentioned in section 4.2.

The four groups were asked to discuss and write down their thoughts pertaining to the evaluation of NIV for the patient presenting with ARF. This section provides a summary of the data collected during the brainstorming session (see Annexure C5). The following question regarding the evaluation of NIV for the patient presenting with ARF was posed to the groups:

*What data should be included when **evaluating** the patient's response to NIV?*

*Where and when should the data be **recorded**, in other words, what documentation is required (e.g. the progress notes or a separate document developed for NIV).*

The following quotations support the findings related to the evaluation of NIV for the patient presenting with ARF.

"… evaluation…it overlaps with the whole process actually…you evaluate right through [nursing process]… not just at the end …"

"…remember to evaluate patient safety … pressure sores…"

"… humidification can burn the patient … evaluate risk factors thereof…"

From the reflections of the participants it is evident that all four groups included mostly the same data during this phase. The aim of the evaluation phase is to determine whether the patient's condition has improved, or whether the patient needs invasive ventilation.

Consensus was reached that continuous monitoring of the patient is essential and that the patient should be closely observed for signs of failure of NIV in order to invasively ventilate the patient timely. Diagnostic tests should be done according to patient-specific needs.

Continuous assessment of the risk factors associated with NIV is vital. Group 4 included the risk of burns caused by the humidified ventilator circuits touching the patient's skin to be assessed. Routine nursing interventions like mouth care should be continued and the effectiveness recorded. All four groups agreed with the following discussions.

Consensus could not be reached on where to record the data. Group 1 suggested recording all patient data on the ICU flowchart, but Group 3 suggested the development of a separate document, for example on the clinical pathway document. Groups 2 and 4 suggested that the researcher should investigate the best alternative to be implemented.

Discussion: The relevant data pertaining to patient assessment, patient monitoring, assessment of risk factors and specific care have already been discussed in sections 4.3.2.2 and 4.3.2.4.

4.4 PHASE 3: DISCUSSION OF RESEARCH FINDINGS

After completing the literature control the researcher developed the draft clinical pathway for NIV and distributed the draft to the participants for evaluation. The participants were requested to evaluate the clinical pathway and care document according to the evaluation instrument included in the participation leaflet and informed consent (see Annexure B4). The researcher used network sampling to recruit participants for phase 3 of the study as described in Chapter 3 (see Section 3.3.2.4).

The feedback was received in the form of written feedback on the clinical pathway as well as completing an evaluation instrument (see Table 4.5), Examples of written feedback are attached (see Annexure D2).

The evaluation instrument required the participants to rate the clinical pathway according to the following criteria:

- clarity
- simplicity
- consistency
- comprehensiveness
- its importance for nursing practice development
- whether it is applicable to the CCU

The rating system consisted of four levels, namely exemplary, proficient, marginal and unsatisfactory. A discussion of the research findings follows.

Table 4.5 Example of an evaluation instrument

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly				
Simplicity				
Consistency				
Comprehensiveness				
Importance for nursing practice development				
Applicable to CCU				
Other (please specify)				

Discussion: The redeveloped draft clinical pathway was distributed to twenty participants, who included the original participants from phase 1 and additional participants who were recruited by means of snowball sampling as discussed in Chapter 3 (see Section 3.3.2.4). Seven of the participants provided feedback, which will be discussed in-depth in the following section.

- **Clarity –user friendly**

Clarity refers to the structure and logical flow of the clinical pathway, in other words, if the content is clear and easily understandable. Three of the seven

participants agreed that the clinical pathway was user friendly and clear. The remaining four participants commented that the clarity was proficient, but that some concepts needed clarification, for example the terminology used might not be familiar to all the nurse practitioners currently working in the CCU.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly	**3**	**4**		

- **Simplicity**

Simplicity refers to the presentation of the clinical pathway and the layout of the information. The simplicity of the clinical pathway was indicated as proficient by six of the seven participants. One participant indicated that the simplicity of the clinical pathway was exemplary.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Simplicity	**1**	**6**		

- **Consistency**

The consistency of the clinical pathway refers to the degree to which the information contained in the clinical pathway is relevant to the specific diseases process and interventions. Six of the seven participants agreed that the consistency of the clinical pathway was exemplary, whilst one participant commented that the consistency is proficient.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Consistency	**6**	**1**		

- **Comprehensiveness**

Comprehensiveness refers to the degree to which the clinical pathway includes all aspects relevant to the commencement of NIV for the patient presenting with ARF in the CCU. All seven participants agreed that the comprehensiveness of the clinical pathway was exemplary.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Comprehensiveness	7			

- **Importance for nursing practice development**

This criterion was included to assess the worth of the clinical pathway for the development of nursing practice. All seven participants agreed that the development of the clinical pathway was of great value to the development of nursing practice.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Importance for nursing practice development	7			

- **Applicable to CCU**

All seven participants rated the clinical pathway as ***exemplary*** regarding the application of the clinical pathway to the CCU setting.

Criteria	Exemplary	Proficient	Marginal	Unsatisfactory
Applicable to CCU	7			

- **Other (please specify)**

Participants were invited to make additional comments regarding the clinical pathway. One of the seven participants commented that the clinical pathway is not suitable for implementation in other departments, but that the use of NIV is a valuable mode of ventilation due to the reduced rates of ventilator associated pneumonia.

It is evident from the feedback received (see Annexure D2) that the participants agreed that the clinical pathway is applicable to the setting. It was suggested that the draft document was too lengthy and should be revised. Participants also commented that the NIV algorithm was too difficult to interpret.

The final document was developed following the feedback from the participants and included the suggestions made by the participants during phase 3 (see Annexure D2). The clinical pathway was simplified and redeveloped (see Annexure E1).

4.5 CONCLUSION

The benefits of NIV for the management of ARF resulting from diverse aetiologies have been established in many studies. The success of NIV depends on several factors including the type of ARF, the presence of underlying pathology, and the experience of the multidisciplinary team with NIV. The experience of the multidisciplinary team is mentioned as one of the important predictors of success with NIV in achieving treatment goals.

Furthermore it is advised that the patient receiving NIV should be admitted to a unit where a high level of monitoring is possible, and where staff are skilled in airway management. If NIV is applied by expert clinicians, up to 50% of patients presenting with acute respiratory distress syndrome avoid endotracheal intubation.

The development of a clinical pathway for NIV in CCU might enhance the collaboration between members of the multidisciplinary team, and provide a guide for the correct and effective management of the patient presenting with ARF.

Chapter 4 was dedicated to the research findings and a discussion relevant to this study. In Chapter 5 the researcher's recommendations are discussed.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 4 was dedicated to an in-depth discussion on the research findings and the relevant literature related to the research findings. In this chapter, the conclusions of the two objectives of the study will be discussed and recommendations based on the research findings will be presented.

5.2 AIMS AND OBJECTIVES

The overall aim of the study was to collaboratively develop a clinical pathway for NIV that can be applied in the CCU.

In order to achieve this aim the following objectives were identified:

- **Objective 1:** Explore the components of a clinical pathway for NIV
- **Objective 2:** Develop a clinical pathway for NIV that can be implemented in the CCU

The realisation of these objectives is discussed in sections 5.3 and 5.4.

5.3 OBJECTIVE 1: EXPLORE THE COMPONENTS OF A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION

The brainstorming session yielded rich data owing to the diverse levels of experience of the participants in the CCU setting, as well as their experiences with regard to NIV. The four themes, namely assessment, planning, implementation and evaluation guided by the conceptual framework utilised in the study (see Figure 1.1) guide the discussion.

5.3.1 Conclusion

The four themes were based on the conceptual framework, and consensus was reached regarding the categories and sub-categories presented during Phase 1. A conclusion relating to each theme is provided.

5.3.1.1 Assessment

The assessment of the patient's suitability for NIV is paramount to its successful application to the adult patient presenting with ARF. From the assessment data collected the researcher established that certain patient groups are favoured for treatment with NIV owing to certain preconceived ideas related to NIV. The lack of defining criteria for the inclusion of patients for treatment with NIV means that patients who might fare well with NIV are often invasively ventilated, despite the obvious risks involved.

Inclusion and exclusion criteria need to be defined before commencing with a treatment plan. The assessment of the patient is vital to the success of NIV, and should be carried out by skilled healthcare professionals. Patients should be assessed individually and the treatment goals should be established for each individual patient.

⇨ **History**

The determination of the treatment goals for the specific patient is facilitated by establishing the health history of the patient. Establishing the co-morbidities and risk factors present on admission to CCU, will guide the multidisciplinary team to set patient specific treatment goals, for example the patient who does not wish to be invasively ventilated or prolong life with artificial means.

Determining the history of the patient will also guide clinical decision making regarding the mode of ventilation and the specific patient needs to ensure optimal therapeutic levels of NIV.

- **Age**

Age was not considered to be a determinant for the use of NIV as indicated in the literature. For this reason, the researcher deemed it unnecessary to include age as a parameter in this clinical pathway.

- **Underlying pathology**

The use of NIV in ARF as a result of diverse pathologies and related aetiologies has been described in the literature. It is therefore recommended that each patient be assessed individually for their suitability for NIV.

Evidence exists for the successful application of NIV in ARF resulting from diverse aetiologies. Patients who undoubtedly benefit from NIV are patients with chronic obstructive pulmonary disease and immune-compromised patients. The benefits of NIV for these groups of patients should not be lost!

- **Social history**

Determining the social history of the patient prior to the commencement of NIV, will assist the multidisciplinary team in identifying potential problems that could lead to the failure of NIV for example intolerance of the mask and the patient who becomes uncooperative due to withdrawal symptoms. The potential problems can be prophylactically managed to prevent the failure of NIV due to these factors.

In the event of anxiety – as seen in most conscious patients admitted to the CCU – the nurse practitioner should endeavour to reassure the patient at all times, as well as act as a patient advocate, and suggest the use of appropriate anxiolytic therapy to the attending physician.

⇨ **Prognosis**

Prognosis should not be a determinant for the management of the patient with NIV. Noninvasive ventilation is the "superior" alternative to invasive ventilation and the patient's and relative's wishes should always be taken into consideration when planning care.

Noninvasive ventilation has a definite role to play in palliative care – supporting the dying patient regardless of the outcome. The treatment goals should however, be clearly stated prior to commencing NIV. For this reason, the patient and relatives should be engaged in discussions with the multidisciplinary team to collaboratively determine treatment goals.

⇨ **Duration of illness**

Certain patient groups are not suited to NIV. These include trauma patients, owing to the severity of traumatic injuries, and patients with facial burns, facial fractures or facial abnormalities that impair mask fit. These patients should be managed with invasive ventilation without hesitation as they are prone to prolonged ventilation.

⇨ **Inclusion criteria**

The use of inclusion criteria were stipulated in the NIV clinical pathway and multidisciplinary care document (see Annexure E1). The individual assessment of a patient's suitability for NIV cannot be over-emphasised. Certain groups of patients should not be excluded from NIV simply because of preconceived ideas harboured by members of the multidisciplinary team. Special consideration should be given to groups of patients who remain ill for extended periods, but who are candidates for NIV. The presence of naso-gastric tubes and false teeth which may impair mask fit and lead to air leaks should be anticipated and managed in the clinical setting.

⇨ **Exclusion criteria**

An altered level of consciousness is one of the main predictors of failure of NIV. Patients with an altered level of consciousness who are unable to protect their airway should not be considered for NIV. Patients with altered cough and gag reflex should be managed with extreme caution when using NIV, owing to the increased risk of aspiration.

Consensus was reached that specific exclusion criteria for NIV should be stipulated. The exclusion criteria are:

- o myocardial infarction
- o congestive heart failure
- o asthma
- o facial injuries, fractures and/or abnormalities
- o vomiting, abdominal distension and/or gastro-intestinal bleed
- o recent surgery to upper airway and/or gastro-intestinal tract
- o haemodynamically unstable patient

⇨ **System orientated assessment**

A complete systems-orientated assessment of the patient should be done at regular intervals. Assessment of the ***central nervous system*** should be done to determine the level of consciousness. The Glasgow Coma Scale may be used as a guideline to establish the patient's suitability for NIV. If the patient remains awake and able to comprehend and cooperate with the nurse practitioner, NIV may be used.

The ***respiratory system*** assessment should include observing for signs of respiratory distress, including use of accessory muscles, nasal flaring, signs of cyanosis, increased respiratory rate, and auscultation of the lung fields. A chest x-ray should be done at the baseline to assess for signs of pneumothorax or haemothorax, acute lung injury and consolidation.

The assessment of the ***cardiovascular system*** should include routine observations of blood pressure, heart rate and rhythm, and peripheral perfusion. Owing to the potential alterations in cardiac output associated with NIV, the

nurse practitioner should observe for changes in these parameters in order to prevent adverse effects.

Diagnostic test as a baseline should include an ECG to exclude the possibility of myocardial infarction, the presence of which effectively excludes the patient from the clinical pathway.

5.3.1.2 Planning

The planning for NIV includes equipment, patient safety, ventilator safety and patient monitoring.

⇨ Equipment

The equipment related to NIV differs in the various CCU settings. Accordingly, the clinical pathway should be developed with this in mind. General consensus was reached that the use of a humidifier is mandatory for the prevention of adverse effects in the patient, as well as to enhance patient comfort.

⇨ Patient safety

There is concern for the safety of the patient with regard to the application of NIV equipment by less skilled nurse practitioners. The continuous education of the nurse practitioners in the CCU with regard to NIV is vital to its successful and safe application. Education and training should be provided on an ongoing basis to assess the level of skill of nurse practitioners and to enhance their competency and patient safety.

The added workload associated with the commencement of NIV should be addressed. Current practice does not allow for the allocation of one nurse practitioner to one patient for the application of NIV. Consequently, the potential benefits of the correct and timely application of NIV might be lost owing to inappropriate staffing. Consensus was reached that the staffing ratio needs to be revised to allow one nurse practitioner to one patient for the first 48 hours to enhance favourable patient outcomes.

The setting of appropriate alarm limits should be included as part of patient safety to prevent adverse effects including injuries to the airway and lungs. Education in this regard should be given to the nurse practitioners. The establishment of a patent intravenous access for the administration of emergency medication is included as part of ensuring patient safety during NIV.

⇨ **Ventilator settings**

Patient tolerance is a major determinant of the success of NIV and ventilator settings should be adjusted accordingly. Consensus regarding specific ventilator settings was reached, and it was determined that the settings should be according to patient needs and patient tolerance.

The current mode of choice in the CCU is BiPAP, as this mode is best tolerated by patients. Patient synchrony with the ventilator can easily be acquired with this mode of ventilation.

During the initiation of NIV the setting for FiO_2 should not exceed 50%. This can be titrated according to patient response which is evident from the arterial blood gas analysis performed at baseline and again after two hours of NIV. Pressure support is initially set at 8 cmH_2O and can be adjusted to enhance patient comfort and tolerance.

⇨ **Patient monitoring**

Patients presenting with ARF require admission to the CCU owing to the risks involved. In the CCU environment routine monitoring of the patient is done hourly and any alteration in their health status can be proactively managed. The appropriate allocation of skilled nursing practitioners ensures that the patient receives the correct treatment at the correct time. The monitoring of vital signs should be done hourly and arterial blood gas values should be assessed two-to-four hourly depending on the patient's response to NIV.

The patient should also be assessed hourly for risk factors including the development of pressure ulcers related to the facemask. These risk factors can be proactively managed in the CCU setting.

- **Haemodynamic monitoring**

The haemodynamic monitoring of the patient should be done continuously to observe for any adverse reactions to NIV. Monitoring and recording of vital signs should be done hourly and alterations reported to the attending physician without delay.

- **Arterial blood gas**

A baseline arterial blood gas measurement should be done prior to commencing NIV. The arterial blood gas values should be reassessed after at least 30 minutes of NIV to establish if any physiological improvement has taken place. The clinical pathway guides the actions of the multidisciplinary team according to the values obtained from the arterial blood gas analysis (see Annexure E1).

Using the clinical pathway will ensure that patients receive the correct intervention at the correct time without unnecessary delays that could prove fatal.

- **Patient comfort**

Patient comfort during NIV is a major predictor of the success or failure of NIV. The literature suggests that the patient be placed in a semi-recumbent position at 45° to promote patient comfort and minimise air leaks that cause poor mask tolerance. The patient should therefore be placed in a semi-fowlers position to promote comfort and lung expansion. The mask size should be determined prior to attaching the mask to the patient's head. The size of the mask can be determined using the manufacturer's guidelines for sizing to ensure a comfortable fit with minimal air leaks.

The formation of pressure sores, particularly on the bridge of the nose is a risk due to the pressure exerted during NIV and improper application of the facemask. The mask should fit the patient comfortably and the head straps should be fastened tight enough to seal the mask but without excessive pressure which could cause skin breakdown and pressure sore formation. The assessment of the pressure areas should be done at least hourly and prophylactic action taken to prevent skin breakdown, for example using a barrier cream and pressure relieving dressings to reduce the risk of pressure sore formation.

The use of a heated humidifier is strongly recommended. The use of a heated humidifier ensures that the medical gases delivered to the patient, resembles that of ambient air in the airways. The risk of drying of the mucosa is reduced thereby protecting the upper airway structures from damage. The risk of burns due to the humidified circuit touching the skin of the patient is small but real. The circuit should be placed in the ventilator attachment designed for this purpose to prevent burn wounds from happening.

5.3.1.3 Implementation

Implementation involves holistic patient care and the initiation of NIV.

⇨ **Holistic patient care**

The patient and his/her relatives need to be informed and reassured at all times. During the planning for NIV the treatment goals should be established in collaboration with the patient and relatives. The specific needs of the patient and relatives should guide the multidisciplinary team in this respect.

- **Patient education**

One of the major advantages of NIV is that the patient's ability to communicate normally is not impaired. This provides an opportunity for the nurse practitioner to reassure the anxious patient continuously as well as provide the patient with health education and an explanation of the procedure.

The patient who is well informed is better able to tolerate the procedure and will be more willing to cooperate with the multidisciplinary team.

- **Spiritual needs**

The holistic patient care approach includes aspects of the patient's spiritual well-being. The nurse practitioner acts as the patient's advocate and should be able to provide for the spiritual needs of the patient. Due to the fact that the patient is able to communicate and eat and drink normally with NIV, the patient is also able to communicate his or her needs with their spiritual counsellor and even part take in spiritual activities for example holy communion and the serving of last rights, should it be requested by the patient.

⇨ **Initiation of noninvasive ventilation**

- **Patient care**

The specific needs of the patient should be addressed and therefore it is recommended that the use of NIV be 'tailored' to the specific patient and not be generalised. Patient tolerance and compliance can be enhanced by ensuring patient-specific settings for NIV.

- **Multidisciplinary team approach**

The clinical pathway was developed to include the members of the multidisciplinary team currently active in the CCU, including physicians, nurse practitioners, physiotherapists and dieticians. The involvement of the entire multidisciplinary team is paramount to the successful application of NIV and to ensure enhanced patient outcomes. Hence, it is essential to ensure the collaboration of all members of the multidisciplinary team.

- **Specific observation**

The assessment of the patient during NIV should be continuous. The patient should be assessed for risk factors as previously discussed and the patient should be kept comfortable. The use of a humidifier reduces the risk for drying of the mucosa but mouth care should be done at least three hourly to alleviate the discomfort of dry mouth. The use of a saline based nasal spray is recommended to alleviate the dryness of the nasal mucosa.

The ventilator settings should be adjusted according to the patient's response to NIV and the results of the arterial blood gas analysis. Pressure settings should be adjusted in increments of 2cmH_2O to prevent patient discomfort and minimise air leaks that might lead to NIV failure.

The patient admitted to CCU requires diligent monitoring. The monitoring of the haemodynamic parameters of the patient should be done at least half hourly for the first two hours and then hourly if the patient is deemed stable. Any alterations in the haemodynamic parameters of the patient should be promptly reported to the physician in charge for further management.

5.3.1.4 Evaluation

The success of NIV should be evaluated to ensure enhanced patient outcomes, and to alter the treatment plan for the patient in a timely manner. Patients who are candidates for invasive ventilation should be intubated promptly to avoid unnecessary delays and the adverse effects of NIV.

Although NIV is considered to be superior to invasive ventilation there are still risks involved. The risk of pressure ulcer formation resulting from the pressure of the mask on the face should be borne in mind. In addition, the potential complications should be anticipated and prevented.

The continuous monitoring of vital data is paramount and alterations in the hemodynamic status should be reported to the attending physician promptly. A multidisciplinary approach to patient management increases the potential for enhanced patient outcomes.

5.4 OBJECTIVE 2: DEVELOP A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION THAT CAN BE IMPLEMENTED IN A CRITICAL CARE UNIT

The data collected during the brainstorming session in Phase 1 of the study were verified by means of a comprehensive literature control (Phase 2) conducted by the researcher. The data were then used to develop the first draft of the clinical pathway which was distributed to the participants for feedback (Phase 3).

5.4.1 Conclusion

The feedback from the participants was analysed and incorporated in the refinement of the final clinical pathway. The written feedback from the participants indicated that the clinical pathway is comprehensive, user friendly and relevant to the CCU, but was lengthy and clarity regarding some terminology was needed for lower categories of nursing staff.

The use of the evaluation instrument provided valuable insights regarding the content, layout and clinical relevance of the clinical pathway. The clinical pathway will need to be implemented and reassessed on a regular basis and adjustments made as new research data becomes available. The true benefits of the clinical pathway will be clearly established once it has been implemented in the CCU, and it will remain a collaborative effort of the entire multidisciplinary team to ensure the relevance of the clinical pathway.

5.5 RECOMMENDATIONS

Recommendations have been made relating to the clinical practice, management, nursing education and future research.

5.5.1 Clinical practice

Clinical pathways are a new concept in the clinical practice in South Africa. Current clinical practices do not make use of clinical pathways, therefore the recommendations are to:

- keep up with international best practices through the development, implementation and evaluation of clinical pathways
- Acknowledge the benefits of clinical pathways to the:
  - *patient*, who receives the appropriate care in the predetermined timeframe, which translates into shorter hospital stay and cost savings
  - *hospital*, which has higher patient satisfaction levels, and
  - *medical aid organisations*, who benefit from cost savings resulting from shortened hospital stays.
- Involve the members of the multidisciplinary team need to enhance collaboration and communication within the multidisciplinary team to ensure favourable patient outcomes

5.5.2 Management

The benefits of implementing clinical pathways have been demonstrated in the literature, but in the current South African healthcare society, the use of clinical pathways is relatively unknown. The support from hospital management is a vital aspect for the successful development and implementation of clinical pathways.

The benefits related to clinical pathways need to be highlighted and brought to the attention of hospital management at large. Quality improvement is one of the benefits of a clinical pathway, but there are barriers to the development thereof.

5.5.2.1 Quality improvement

The development, implementation and evaluation of clinical pathways are recommended to:

- enhance the standardisation of healthcare delivery to patients
- decrease discrepancies, which in turn may reduce the number of legal claims related to patient care in the hospital environment
- meet the expectations of patients pertaining to quality care as the broad access of patients to information means that patients today are well informed and have preconceived ideas related to healthcare delivery
- enhance collaboration between multidisciplinary team members which in turn may maintain and increase customer satisfaction
- empower patients to make informed decisions about their care and are able to cooperate with the multidisciplinary team to achieve the predetermined treatment goals

5.5.2.2 Barriers to clinical pathway development

Overcome barriers to develop clinical pathways by:

- ensure that relevant resources are available, because the development, implementation and evaluation of clinical pathways require time and money – both scarce resources.
- Motivate hospital management to invest in the development, implementation and evaluation of clinical pathways

- change the mindset of nurse practitioners and multidisciplinary team members pertaining to clinical pathway and the use thereof in the clinical practice

5.5.3 Nursing education

Nursing education should attend to the following aspects:

- address the knowledge gaps and the need for continuous professional development of nurse practitioners pertaining to the development, implementation and evaluation of clinical pathways
- ensure that nurse practitioners encompass the knowledge, skills and attitudes relating to NIV
- promote in-service training programmes with regard to NIV and the correct application of the clinical pathway

5.5.4 Future research

Future research relating to clinical pathways should include:

- implement and refine the clinical pathway for NIV
- identify specific topics on which clinical pathways could be developed
- develop, implement and evaluate clinical pathways for different clinical practice
- monitor and evaluate the benefits when clinical pathways are implemented in the clinical practice

5.6 PERSONAL REFLECTION

A good puzzle, it's a fair thing. Nobody is lying. It's very clear, and the problem depends on just you.

Erno Rubik

My passion for the nursing profession was reawakened during the past two years whilst involved in this study. The personal and professional growth experienced

by me is not easily put into words. The tumultuous emotions brought on as the study progressed brought me to new insights regarding current-day practice.

During the course of the study I encountered some opposition from CCU colleagues who were resistant to new ideas and change, for example changing from using CPAP as the preferred mode of NIV to BiPAP, which was an unfamiliar mode. I also found that it was really difficult to convince some nurse practitioners and physicians to sacrifice personal time to this endeavour.

Collaboration between members of the multidisciplinary team is the key to enhancing patient outcomes on all levels and can be achieved through knowledge and evidence-based practice, because patient care can not be fragmented into certain areas of responsibility. Patients deserve to be treated holistically, and therefore the input of the entire multidisciplinary team is essential.

There is a great need to alter the perception that research is abstract and incomprehensible. In order for the nursing profession to move forward and practice remain evidence-based and current, research should form the basis of patient care. Research should be encouraged and research findings should be studied and implemented accordingly. Evidence-based practice provides the answer to many clinical questions, and a mind shift should be cultivated to incorporate research in practice.

Apart from the negative aspects encountered, I was thrilled to notice that some of the younger generation nurse practitioners were extremely enthusiastic about the study, and contributed more to the study than I expected of them as participants.

I observed and experienced that collaboration with the different members of the multidisciplinary team was less troublesome than initially expected. My efforts was well rewarded in the end as all the members felt valued and appreciated for contributing to the development of the clinical pathway. The feedback from the multidisciplinary team, overall, was very positive.

I realised that bringing about change is a collaborative effort, and that change starts within oneself. Altering preconceived ideas is not always a pleasant experience, but the rewards in terms of personal and professional growth are overwhelming. The completion of this study has left me with an overwhelming sense of achievement and pride – both personally and professionally.

The completion of this study was made possible by the selfless efforts of all the participants. These are the people who have made this dream a reality. This is the product of collaborative effort. I acknowledge each person's contribution and give thanks to everyone who was involved in the development of the clinical pathway for NIV.

5.7 SUMMARY

Great discoveries and improvements invariably involve the cooperation of many minds. I may be given credit for having blazed the trail, but when I look at the subsequent developments I feel the credit is due to others rather than to myself.

Alexander Graham Bell

Noninvasive ventilation is a relative new concept and mode of mechanical ventilation. Recognising that there was a need for consensus amongst the members of the multidisciplinary team in the CCU pertaining to the utilisation of NIV, the researcher opted to develop such a clinical pathway.

The nursing process, used as a conceptual framework, guided the research. The components of the nursing process, namely assessment, planning, implementation and evaluation were the four main themes guiding the development process.

The study involved three phases, namely Phase 1: components of a clinical pathway, Phase 2: literature control and Phase 3: Development of a clinical pathway. In Phases 1 and 3, collaboration between members of the

multidisciplinary team was encouraged. Inputs from all the participants were included and consensus was reached on a clinical pathway for NIV, which will be implemented in the CCU in future.

Annexure A

Ethical approval

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A.1

Ethics committee
University of Pretoria

Annexure B

Participation information

B.1

Invitation to participate

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

B.2

Participant information CD

B.3

Participation leaflet and Informed consent : Phase 1

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YUNIBESITHI YA PRETORIA

B.4

Participation leaflet and Informed consent : Phase 3

Participation leaflet and informed consent

Developing a draft clinical pathway for non-invasive ventilation

Dear Colleague

You are invited to participate in the development of a clinical pathway for the use of non-invasive ventilation (NIV) in the critical care unit (CCU) that will take place over a period of twelve months within the CCU. This information leaflet contains information that will help you understand your role in the study. If there is any need for further clarification, please feel free to contact the researcher at any time.

TITLE OF STUDY

Developing a draft clinical pathway for noninvasive ventilation (NIV).

1) The purpose and objectives of the study

You are requested to take part in **Phase 1** of a research study. Your participation will be as a member of the multidisciplinary team in CCU.

Invasive mechanical ventilation is associated with complications such as trauma to the airway, hospital and ventilator acquired infections, prolonged hospitalisation and increased costs. Non-invasive ventilation is a relatively new mode of ventilation that has gained more support during the past decade, mainly due to the fact that these complications can be reduced or avoided. Although evidence exists to support the use of NIV, there are no explicit guidelines for the initiation and use of NIV.

The aim of this study is to collaboratively develop a draft clinical pathway for the use of NIV that can be implemented in the CCU.

In order to achieve this aim, the objectives and specific objectives of the research, are listed below:

In order to achieve this aim, the objectives of the research will be to:

- collaboratively develop a draft clinical pathway for NIV
- validate the clinical pathway through literature control

2) Explanation of procedures to be followed

Your participation as a member of the multi-disciplinary team in the CCU will be to collaborate with other members of the multi-disciplinary team to construct a draft clinical pathway for NIV that can be implemented in CCU. Brainstorming sessions will be scheduled and the date and time made available in advance on the notice board in the tea room. An outline of the procedure is depicted below:

In order to facilitate the brainstorming sessions, these steps will be followed:

Step 1: Introduction to the study and the aims and objectives of the study. Informed consent will be signed by the participants.

Step 2: Reach concensus on the ground rules for this brainstorming session. Kreitner and Kinicki (2007:391) suggest the following ground rules:

- Defer judgement: Do not criticise during the initial stage of idea generation/phrases such as “it won’t work”, or “management will never agree” or “everybody will never follow the same clinical pathway” should not be used
- Build on the ideas of others: Encourage out-of-the-box thinking/ the wider or more outrageous the ideas the better
- Go for quantity over quality: participants should try to generate and write down as many new ideas as possible/focusing on quantity encourages people to think beyond their favourite ideas
- Be visual: the use of different coloured pens provided to write on the flipcharts
- Stay focused on the topic: the facilitator will keep the discussion on target and walk between the groups to ensure the group members stay focused
- One conversation at a time: the ground rule applies that no one should interrupt another person, no dismissing of someone else’s ideas, no disrespect and no rudeness
- The group members will be granted the opportunity to add to the ground rules

Step 3: Individual participants will be asked to silently generate ideas or alternatives to the open-ended questions posted on the PowerPoint presentation. This step is included , as silent idea generation is preferable over the practice of having group members randomly shout out their ideas , because it leads to a greater number of unique ideas (Kreitner & Kinick 2007:390).

Step 4: Individuals share their ideas/alternatives with the sub-group members
Step 5: Each sub-group develops a clinical pathway on the flip chart. Stationery will be provided for this step.
Step 6: One participant of each sub-group will discuss the clinical pathway
Step 7: Input from all sub-groups will be utilised in a "think tank" to develop a preliminary clinical pathway and consensus reached regarding the content thereof
Step 8: Participants will be thanked for their input and refreshments will be served.

3) Risk and discomfort involved

As a participating practice leader, you will experience no discomfort. There is also no risk involved in this study. However, your input into this project will require a lot of time and effort.

4) Benefits of the study

Research has confirmed the benefits of NIV, including decreased lung injuries, reduced infection rates, decreased length of stay, decreased cost, and enhanced patient comfort. The collaborative efforts of the members of the multi-disciplinary team might enhance communication amongst team members, as well as show a positive impact on patient outcomes.

5) Voluntary participation in and withdrawal from the study

Participation occurs on a voluntary basis, and you can withdraw from the project without stating any reason should you no longer wish to take part.

6) Ethical approval

The Faculty of Health Sciences' Research Ethics Committee at the University of Pretoria, has granted written approval for this study.

7) Additional information

If you have any questions about your participation in this research project, you should contact the researcher, Liezl Balfour –

Work telephone: (011) 812 4063
Mobile phone: 083 703 2755
Email address: liezlbalfour@mweb.co.za

8) Confidentiality

Your input into this research will be kept confidential. Results will be published and presented in such a manner that you as a participant will remain anonymous.

9) Consent to participate in this study

Your participation in this research is subject to reading and accepting the above information and signing the informed consent document below. A copy of the signed consent document will be given to you.

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of me. Its content and meaning have been explained to me. I have been given the opportunity to ask questions and received satisfactory answers. I hereby volunteer to take part in this research.

_____ _____

Participant's signature **Date**

_____ _____

Person obtaining informed consent **Date**

_____ _____

Witness **Date**

_____ _____

Liezl Balfour **Date**

Researcher

Participation leaflet and informed consent

Developing a final clinical pathway for noninvasive ventilation

Dear Colleague

You are invited to participate in developing a final clinical pathway for the use of non-invasive ventilation (NIV) in the critical care unit (CCU) that will take place over a period of twelve months within the CCU. This information leaflet contains information that will help you understand your role in the study. If there is any need for further clarification, please feel free to contact the researcher at any time.

TITLE OF STUDY

Developing a clinical pathway for noninvasive ventilation (NIV).

1) The purpose and objectives of the study

You are requested to take part in **Phase 3** of a research study. Your participation will be as a member of the multidisciplinary team. During this phase of the data collection, the focus will be on reaching consensus and finalising the clinical pathway for implementation in the CCU.

Invasive mechanical ventilation is associated with complications such as trauma to the airway, hospital and ventilator acquired infections, prolonged hospitalisation and increased costs. Noninvasive ventilation is a relatively new mode of ventilation that has gained more support during the past decade, mainly due to the fact that these complications can be reduced or avoided. Although evidence exists to support the use of NIV, there are no explicit guidelines for the initiation and use of NIV.

The aim of this study is to collaboratively develop a final clinical pathway for the use of NIV that can be implemented in the CCU. In order to achieve this, the aim of these sessions will be to :

- Reach consensus on the components/content of the final clinical pathway for NIV to be implemented in CCU.

2) Explanation of procedures to be followed

You are invited to participate in a collaborative effort to evaluate the content of the c\draft clinical pathway that has been developed for NIV. The following is expected of you:

- **Step 1:** Please read through the document and make comments in writing on the clinical pathway. Should you not be in agreement aboput the information, please attach the relevant evidence, for example the research article, to the document.
- **Step 2:** Use the evaluation instrument provided to evaluate the content of the clinical pathway.
- **Step 3:** Return the clinical pathway (comments included) and the evaluation instrument to the researcher before or on **20 September 2010.**

3) Risk and discomfort involved

As a participating practice leader, you will experience no discomfort. There is also no risk involved in this study. However, your input into this project will require a lot of time and effort.

4) Benefits of the study

Research has confirmed the benefits of NIV, including decreased lung injuries, reduced infection rates, decreased length of stay, decreased cost, and enhanced patient comfort. The collaborative efforts of the members of the multi-disciplinary team might enhance communication amongst team members, as well as show a positive impact on patient outcomes.

5) Voluntary participation in and withdrawal from the study

Participation occurs on a voluntary basis, and you can withdraw from the project without stating any reason should you no longer wish to take part.

6) Ethical approval

The Faculty of Health Sciences' Research Ethics Committee at the University of Pretoria, has granted written approval for this study.

7) Additional information

If you have any questions about your participation in this research project, you should contact the researcher, Liezl Balfour –

Work telephone: (011) 812 4063

Mobile phone: 083 703 2755

Email address: liezlbalfour@mweb.co.za

8) Confidentiality

Your input into this research will be kept confidential. Results will be published and presented in such a manner that you as a participant will remain anonymous.

9) Consent to participate in this study

Your participation in this research is subject to reading and accepting the above information and signing the informed consent document below. A copy of the signed consent document will be given to you.

INFORMED CONSENT

I have read the above information leaflet and fully understand what is expected of me. Its content and meaning have been explained to me. I have been given the opportunity to ask questions and received satisfactory answers. I hereby volunteer to take part in this research.

_____ _____

Participant's signature **Date**

_____ _____

Person obtaining informed consent **Date**

_____ _____

Witness **Date**

_____

Liezl Balfour

Researcher

EVALUATION INSTRUMENT

Please indicate with an 'x' the answer that best describes your impressions of the clinical pathway for NIV according to the set criteria:

EVALUATION INSTRUMENT

	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly				
Simplicity				
Consistency				
Comprehensiveness				
Importance for nursing practice development				
Applicable to CCU				
Other (please specifiy)				

Additional comments:

_____

_____

_____

_____

_____

Thank you for your time and effort. It is much appreciated.

Annexure A

Ethical approval

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

A.1

Ethics committee
University of Pretoria

UNIVERSITEIT VAN PRETORIA
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UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee

31/03/2010

Number	:	**S32/2010**
Title	:	Constructing a clinical pathway for non-invasive ventilation
Investigator	:	L Balfour, Department of Nursing Science, University of Pretoria (SUPERVISORS: Mrs IM Coetzee / Dr T Heyns)
Sponsor	:	**None**
Study Degree:		**M. Cur (Clinical)**

This Student Protocol was approved by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria on 30/03/2010. The approval is valid for a period of 3 years.

Prof M J Bester	BSc (Chemistry and Biochemistry); BSc (Hons)(Biochemistry); MSc(Biochemistry); PhD (Medical Biochemistry)
Prof V.O.L. Karusseit	MBChB; MFGP (SA); MMed (Chir); FCS (SA)
Prof J A Ker	MBChB; MMed(Int); MD – Vice-Dean (ex officio)
Dr M L Likibi	MBChB; Med.Adviser (Gauteng Dept.of Health)
Dr MP Mathebula	Deputy CEO: Steve Biko Academic Hospital
Prof T S Marcus	(Female) BSc (LSE), PhD (University of Lodz, Poland)
Mrs M C Nzeku	(Female) BSc(NUL); MSc Biochem(UCL,UK)
Prof A Nienaber	(Female) BA (Hons) (Wits); LLB (Pretoria); LLM (Pretoria); LLD (Pretoria); PhD; Diploma in Datametrics (UNISA)
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Dr R Reynders	MBChB (Pret), FCPaed (CMSA) MRCPCH (Lon) Cert Med. Onc (CMSA)
Dr T Rossouw	(Female) MBChB.(cum laude); M.Phil (Applied Ethics) (cum laude), MPH (Biostatistics and Epidemiology (cum laude), D.Phil
Prof T J P Swart	BChD, MSc (Odont), MChD (Oral Path), PGCHE
Dr R Sommers	**Vice-Chair** (Female) - MBChB; MMed (Int); MPharMed.
Prof C W van Staden	**Chairperson** - MBChB; MMed (Psych); MD; FCPsych; FTCL; UPLM; Dept of Psychiatry
Mr Y Sikweyiya	MPH (Umea University Umea, Sweden); Master Level Fellowship (Research Ethics) (Pretoria and UKZN); Post Grad. Diploma in Health Promotion (Unitra); BSc in Health Promotion (Unitra)

Student Ethics Sub-Committee

Prof R S K Apatu	MBChB (Legon,UG); PhD (Cantab); PGDip International Research Ethics (UCT)
Dr A M Bergh	(female) BA (RAU); BA (Hons) (Linguistics) (Stell); BA (Hons) (German) (UNISA); BEd (Pretoria); PhD (Pretoria); SED (Stell)
Mrs N Briers	(female) BSc (Stell); BSc Hons (Pretoria); MSc (Pretoria); DHETP (Pretoria)
Dr S I Cronje	BA (Pretoria); BD (Pretoria); DD (Pretoria)
Prof D Millard	(female) B.Iur (Pretoria); LLB (Pretoria); LLM (Pretoria); AIPSA Diploma in Insolvency Law (Pretoria); LLD (UJ)
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Dr R Sommers	**Vice-Chair** (Female) MBChB; M.Med (Int); MPhar.Med

.....

DR L SCHOEMAN; BPharm, BA Hons (Psy), PhD; Dip. International Research Ethics
CHAIRPERSON of the Faculty of Health Sciences Student Research Ethics Committee, University of Pretoria

.....

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Annexure C

Evidence of data collection

C.1

Brainstorming session

C.2

Assessment data: Groups 1-4

Summary of Theme 1 – Assessment data: Groups 1-4

THEME: Assessment			
CATEGORY: History			
SUB-CATEGORY: Patient history and special considerations			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
HISTORY – Age Underlying pathology **SOCIAL HISTORY**- Smoker, Alcoholic **PROGNOSIS** **INCLUSION CRITERIA** **EXCLUSION CRITERIA**	**HISTORY –** Age Underlying pathology **SOCIAL HISTORY**- Smoking, alcohol **PROGNOSIS** **DURATION OF ILLNESS** **INCLUSION CRITERIA** **EXCLUSION CRITERIA**	**HISTORY:** Age Underlying pathology *Social history not mentioned* **PROGNOSIS** **INCLUSION CRITERIA** **EXCLUSION CRITERIA** **EDUCATION** Patient, family Informed consent Personnel, Environment, Equipment	**HISTORY:** *Age not mentioned* Underlying pathology *Social history not mentioned* **PROGNOSIS** **EXCLUSION CRITERIA** **EDUCATION** Education – patient, family False teeth, facial abnormalities
CONSENSUS:			

- **History**:Age,Underlying pathology, Social history should be considered – persons with a history of smoking usually do not tolerate NIV well. Alcohol abuse should be considered – withdrawal symptoms cause the patients become uncooperative, as well as social drug use.
- **Prognosis –** the dying patient, do not resuscitate directives/living will
- **Duration of illness (trauma patients)**
- **Inclusion criteria:** Patients suffering from COPD and pneumonia, immune-compromised patients
- **Exclusion criteria:** Acute MI, Previous MI, Congestive heart failure (CHF), severe asthma, facial injuries or fractures, facial abnormalities, abdominal distention, GI bleed, hemodynamic instability

Summary of Theme 1 – Assessment data: Groups 1-4

THEME: Assessment			
CATEGORY: Systems assessment			
SUB-CATEGORY: Central Nervous System (CNS) assessment			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Glasgow Coma Scale Level of consciousness Sedation / analgesia	Glasgow Coma Scale Level of consciousness Sedation / analgesia	Level of consciousness	Glasgow Coma Scale Level of consciousness
CONSENSUS:			
CENTRAL NERVOUS SYSTEM: • Level of consciousness • Awake • Co-operative • Not according to GCS only			

Summary of Theme 1 – Assessment data: Groups 1-4

THEME: Assessment			
CATEGORY: Systems assessment			
SUB-CATEGORY: Respiratory system			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Respiration rate Accessory muscles Auscultate lungs for air entry Signs of respiratory distress Arterial blood gas values, SpO_2 Secretions	Respiration rate Accessory muscles Auscultate lungs for air entry Signs of respiratory distress Areterial blood gas values	**INSPECTION** – Respiratory rate, Signs of distress, respiration rate, SaO_2, SpO_2 **AUSCULTATION**- Abnormal breath sounds, Adventitious breath sounds **PERCUSSION** – Hyper/hypo resonant sound (confirms diagnosis) **PALPATION** – Symmetry	Respiratory rate Accessory muscles Auscultate lungs for air entry Signs of respiratory distress Arterial blood gas values Secretions
CONSENSUS:			
RESPIRATORY: • Respiratory rate • Accessory muscle use • Arterial blood gas values • SpO_2 • Signs of respiratory distress • Bilateral air entry • Cyanosis – peripheral and central • Secretions – amount and colour Include : • "look" (Inspection) • "listen" (Auscultation) • "feel" (Percussion)			

Summary of Theme 1 – Assessment data: Groups 1-4

THEME: Assessment			
CATEGORY: Systems assessment			
SUB-CATEGORY: Cardiovascular System (CVS)			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Haemodynamically stable	Hemodynamically stable	Hemodynamically stable	*Not mentioned*
CONSENSUS:			
CARDIOVASCULAR: • Hemodynamically stable – all parameters within normal ranges • Exclude MI			

THEME: Assessment			
CATEGORY: Systems assessment			
SUB-CATEGORY: Diagnostic tests			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
DIAGNOSTIC TESTS: Chest x-ray Arterial blood gas: Blood tests: CRP,PCT,WCC *ECG not mentioned*	**DIAGNOSTIC TESTS:** Chest x-ray Arterial blood gas Blood tests: UKE,FBC, Cardiac enzymes, CRP, PCT, Ca^{2+}, Mg^{2+}, PO_4 ECG	**DIAGNOSTIC TESTS:** Chest x-ray Arterial blood gas *ECG not mentioned*	**DIAGNOSTIC TESTS:** Arterial blood gas values *ECG not mentioned*
CONSENSUS			
DIAGNOSTIC TESTS: • Chest X-ray • Arterial blood gas values – pH, oxygenation, ventilation,lactate,$AsDpO_2$,FiO_2/pO_2 ratio, shunt • Sepsis markers and routine blood tests			

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C.3

Planning data: Groups 1-4

Summary of Theme 2: Planning data – Groups 1-4

THEME: Planning			
CATEGORY: Equipment			
SUB-CATEGORY*: *Equipment related to NIV			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Ventilator Correct mask Humidifier Monitoring equipment	Ventilator Correct mask *Humidifier not mentioned* Monitoring equipment Prescription for NIV IV access	Ventilator Correct mask *Humidifier not mentioned* Monitoring equipment Personnel to perform NIV	Ventilator Correct mask Humidifier Monitoring equipment
CONSENSUS			
• According to what is used in your hospital • Establish IV access for emergency medication • Humidifier			

THEME: Planning			
CATEGORY: Patient safety			
SUB-CATEGORY: Education of nursing practitioners			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Not mentioned	*Not mentioned*	Skill and knowledge of nurse practitioner	Skill and knowledge of nurse practitioner
CONSENSUS			
• Nurses should be educated continuously to ensure the correct and safe application of NIV • Patients receiving NIV need constant reassurance and monitoring and therefore the staffing ratio should be 1:1			

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Summary of Theme 2: Planning data – Groups 1-4

THEME: Planning			
CATEGORY: Ventilator settings			
SUB-CATEGORY: Settings and alarms			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Percentage oxygen at start *Not mentioned*	*Not mentioned* Settings according to prescription	*Not mentioned*	Percentage oxygen at start Settings should be patient specific
CONSENSUS			
• Patient specific • Start with lower settings for example pressure support and peak flow to minimise patient discomfort, and maximise physiological improvement			

THEME: Planning			
CATEGORY: Patient monitoring			
SUB-CATEGORY: Hemodynamic monitoring			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Continuous monitoring of all systems	Continuous monitoring of all systems Time frame	Continuous monitoring of all systems Time frame Risk factors	Continuous monitoring of all systems Time frame Risk factors
CONSENSUS			
• Continuous monitoring of the patient • Time frame to be established • Risk factors to be monitored			

Summary of Theme 3: Implementation data – Groups 1-4

THEME: Implementation			
CATEGORY: Holistic patient care			
SUB-CATEGORY: Patient education			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Continuous communication with patient Explain procedure to patient and family	Continuous communication with patient Explain procedures to patient and family	*Not mentioned* *Not mentioned*	Continuous communication with patient Explain procedure to patient and family
CONSENSUS			
• Continuous communication and information to patient and relatives			

THEME: Implementation			
CATEGORY: Initiation of NIV			
SUB-CATEGORY: Patient care			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Monitor and prevent risk factors General nursing care Continuous monitoring	Monitor and prevent risk factors General nursing care Continuous monitoring	Monitor and prevent risk factors General nursing care Continuous monitoring	Monitor and prevent risk factors General nursing care Continuous monitoring
CONSENSUS			
• Some content overlapping with planning phase. • This phase should be termed "Initiation phase" in clinical pathway • Obtain informed consent from patient and/or relatives • Establish baseline data • Correct positioning of patient • Ensure knowledgeable staff allocated to patient care			

Summary of Theme 3: Implementation data – Groups 1-4

THEME: Implementation			
CATEGORY: Initiation of NIV			
SUB-CATEGORY: Multidisciplinary team approach			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Management of patient to include Physiotherapist Physician	Management of patient to include Physiotherapist Dietician Physician Nurse practitioner Pharmacist Radiologist Pathology laboratory Case manager Spiritual needs of patient for example pastor	Management of patient to include • Physiotherapist • Physician	Management of patient to include • Physiotherapist • Physician
CONSENSUS			
• Patient should receive lung physiotherapy as needed • Physician to prescribe medication • Nurse practitioner to be competent to care for patient receiving NIV • Chest X-ray to be done daily to assess improvement • Assess spiritual needs of patient			

C.4

Implementation data: Groups 1-4

Summary of Theme 4: Evaluation data – Groups 1-4

THEME: Evaluation			
CATEGORY: Physiological elements			
SUB-CATEGORY: Multidisciplinary approach			
Group 1	**Group 2**	**Group 3**	**Group 4**
Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care
CONSENSUS			
• Continuous systematic assessment, including hemodynamic parameters and diagnostic tests • Risk factors • Patient care including mouth care			

Summary of Theme 3: Implementation data – Groups 1-4

THEME: Implementation			
CATEGORY: Initiation of NIV			
SUB-CATEGORY: Initiation phase (specific observations)			
GROUP 1	**GROUP 2**	**GROUP 3**	**GROUP 4**
Hemodynamic monitoring hourly Alarm settings Patient specific	Hemodynamic monitoring hourly Alarm settings Patient specific Risk factors	Hemodynamic monitoring hourly Alarm settings Patient specific	Hemodynamic monitoring hourly Alarm settings Patient specific
CONSENSUS			
• Correct equipment • Correct settings and alarms • Hemodynamic monitoring should be patient specific			

C.5

Evaluation data: Groups 1-4

Summary of Theme 4: Evaluation data – Groups 1-4

THEME: Evaluation			
CATEGORY: Physiological elements			
SUB-CATEGORY: Multidisciplinary approach			
Group 1	**Group 2**	**Group 3**	**Group 4**
Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care	Reassess patient for improvement Continuous monitoring of all systems and risk factors Patient specific needs e.g. mouth care
CONSENSUS			
• Continuous systematic assessment, including hemodynamic parameters and diagnostic tests • Risk factors • Patient care including mouth care			

C.6

Group consensus

CVS
- Hemodinamic status (include unstable pt due to hip
optimal
- Fluid status
- Hb ↑ 8-10 g/dl/l
-

→ Consent < pt / family

→ Baseline data

→ Equipment
- mask
- ~~Equipment~~ Ventilator
- suctioning
- Monitors (Hemodinamic sats ext)

Pt

→ Position

→ Initiate – NIV

→ Settings
- FiO2
- PEEP
- PIS

+ Alarms

→

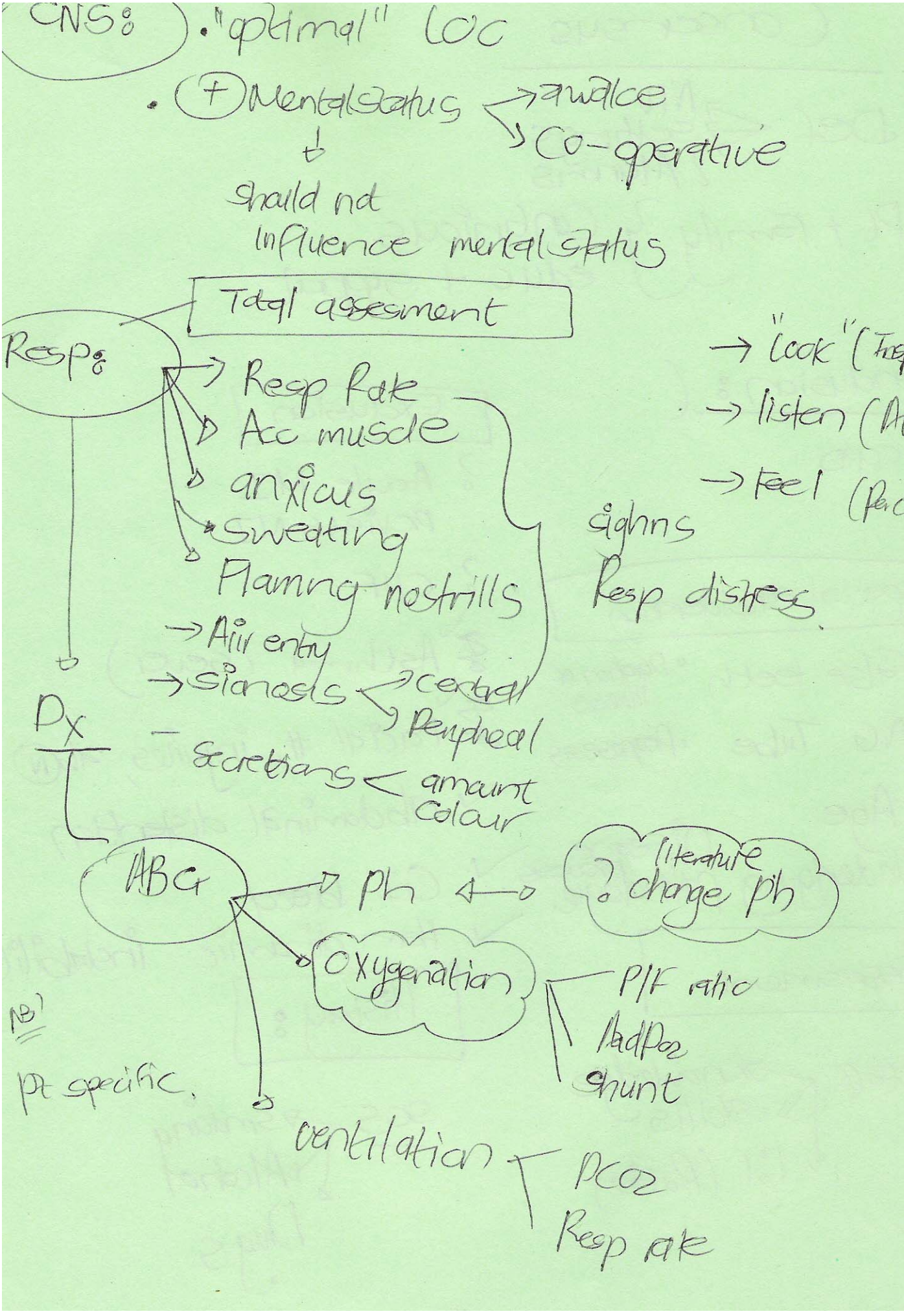
→ Critically ill

→ systemic evaluation. (Baseline dat
- → All syste
- → Dx test

→ Be "comfard" of pt

→ Pressure sores

→ Mouthcare


CNS:
"optimal" LOC
(+) Mental status
awake
Co-operative
should not influence mental status
Total assessment
Resp:
Resp Rate
Acc muscle
anxious
Sweating
Flaring nostrills
Air entry
Signs
Resp distress
"look"
listen
feel
Cyanosis
central
Peripheral
Px
Secretions
amount
colour
ABG
literature
change ph
ph
Oxygenation
P/F ratio
AaDO2
Shunt
NB!
pt specific.
ventilation
PCO2
Resp rate

Consensus

- Def ⇄ NIV
  Settings
  ? Alarms
- Pt + Family } Continious
  educ + support

Inclusion: (

→ COPD

Exclusion

? Acute MI
previous MI

? CHF

Asthma (sever)

Facial #, injuries, ab

abdominal distention

GI bleed

Hem diramic instab

Special consideration

- False teeth
- Duration of illness
- NG Tube
- Prognosess
- Age
- Underlying pathologe
- Disease process

Assesment

Staff → Knowledge
Skills
1:1 (Ratio)

History:

SOS → Smoking
Alcohol
Drugs

C.7

Transcription of brainstorming session

Interview 1

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Name: Liezl Balfour

Time: 01:36:22

Comments	Participant	Transcription
	I	Ok, shall we start? Ok who wants to go first? Shall we start with group one? I just want to know can I bring the table over here when group one speaks?
	P	I think this is a good idea.
	I	All right group one?
	P	Ok we said uhm we started with the history. There was specific things under assessment in the history that we thought uh is important and we said the one important thing that we think is to really determine what is the, you know what specific age should the patient be because we said that sometimes they really, all this old people they don't really want to intubated, they put them on and then the age can be a problem. The other aspect we also said that we have to assess for uh under the history is to really determine the underlying pathology. To make sure that the patient is actually a good candidate for non-invasive, that they are not too sick and they are not patients that should actually be intubated from the beginning. And then also under the history, socially we said there's uh a really also two important aspect we as a group identified and those are for instance your patients that are heavy smokers and that uhm, uhm are, consumes a lot of alcohol because they get a lot of DT's and they don't cope on the, on the so they tolerate it, they don't tolerate it well. So those are specific aspects that we have identified. And then under the...

	I	I just need to clarify this, sorry, you will not over a certain age?
	P	Yes.
	I	You saying depending on the underlying pathology and then those two will actually...
	P	Will also not be good candidates because they don't tolerate it well.
	I	Ok.
	P	Because they have DT's and they don't, they don't do well on that so those are important aspects to assess for in the social history. Uhm can we go through all the systems what we said?
	I	Ja.
	P	Ok then under, also under the assessment, uh the central nervous system, we said that there we'll use, we'll, we have to assess the patient's glasco-coma scale or his level of consciousness. So at least the glasco, we said should be about 13 to 15 so they must be, uh the must be awake, they must be able to co-operate. And also to assess the underlying mental status, so make sure that they are not clu-, know not too confused or aggressive because then they also don't co-operate and they take off the mask. And also just to make, to assess there's a level, sedation status, uh that they not too sedated uhm or you know so that they are able to co-operate there. Uhm then under respiratory system; uhm as a group we said also very important to assess the patients respiratory rate. Uhm preferably up to about 30, maybe 35, the respiratory rate. Also have to assess for the use of any accessory muscles.

		Uhm also then the peripheral saturation, although we know it's not such a good indicator it still has some clinical value, to assess the saturation. Uhm then also to ask for air entry. Uhm to also assess the secretions, the amount and the colour and then to also observe for any cyanoses, peripherally or centrally. And then under the diagnostic test under respiratory we just said uhm obvious the x-ray can have uhm valuable, we can get valuable information.
	I	*(Loss of data).*
	P	The secretions, uhm cyanoses.
	I	Ok.
	P	Ja. Uhm then under diagnostic test uh under respiratory we said that obvious on the blo-, the x-ray's is important so that we also you know assess the underlying pathology and the disease process but on the blood case also specific then to look at the oxygenation status. Uhm specifically then to look at the PF uh ag the rather PF ratio or then the shunt in the AODPO2 and also there the lactate levels can give you actually a good, is also a valuable parameter to look at and then to also assess the ventilation status. Ok right, then cardiovascular system; uhm ok there we said the m-, the ma-, almost the most important thing there the patient should be hemodynamically stable. Uhm so also that was actually one of our exclusion criteria, if the patient is hemodynamically unstable

		you shouldn't uh his not a good candidate for non-invasive so we want him to be hemodynamically stable, specifically pertaining to the blood pressure and the heart rate and then to have a HP of at least about 8 to 10 gram per *(loss of data).* And also then just important to ensure optimal fluid status. *(Short silence).* That was the most important things we had under assessment. Uhm then the other thing we just, we did, what we thought we actually sort of made a list for excluding patients. We didn't decide which one should be on but we decided which should not, who should not be or who is not a good candidate. So I think you also should assess for. Uhm so we also, we actually set an exclusion list or patients who should be excluded from non-invasive. Uhm we actually said there uhm patients with myocardio infarctions, congestive heart failure, uhm asthma, COPD, uhm any patient that has uh at risk for aspirations, specifically your patients with, with uhm gastro-intestinal detention, patients with GI bleedings, uhm patients who are obviously hemodynamically unstable. Uh patients with decreased level of consciousness and patients with facial fractures…
	I	*(Loss of data).*
	P	Yes facial fractures or injuries. And then also we said in there and it's almost your sort of claustrophobic patients. They, they, they don't cope well at all. Ok and that's our, and asthma we said in COPDO, ok that's our list.
	I	That's claustrophobic.

	P	Oh ok I said, oh I can't spell this.
	I	Aspiration, CODP and?
	P	Patient's abdominal detention.
	I	Abdominal detention.
	P	Ja we thought easier to say who should not be then who should. You know if you not excluded you are included.
	Group	*(Laughing).*
	P	All right, that's what we have as a group basically concluded on under uhm...
	I	Ok, thank you very much.
	P	...assessment.
	I	Group two?
	P	Must we go on with uh assessment or start with planning?
	I	No assessment and then planning.
	P	Oh my assessment.
	I	Then we will go to-to the next round.
	P	Ok. Uhm we had more, more or less the same than group one. All that uhm we have added at the history uh is what you expect the duration of the illness will be and then the uh prog-...
	I	Why specifically duration?
	Group	*(Loss of data due to overlapping group conversations).*
	I	On the long term?
	P	Say for instance it's uh you think it's going to be a long, it's a trauma, trauma patient it's going to be a long term patient then you'd rather intubated him.
	I	Ok.
	P	Ja.
	I	So the longer you predict it will be...

	P	Yes.
	I	...then you will take this option.
	P	Yes and then also the prognoses which we have included there.
	I	Oh ok.
	P	Uhm and then uhm also uhm the uhm patient with like I said with brain injuries and then sedation like when they coming out of the street with lots of alcohol toxicity and drug uhm toxicity uhm...
	I	We can actually add drugs over here.
	P	Yes.
	I	Ja?
	P	Uhm and then uhm it's also like including and excluding *(laughing)* but we also said like injuries you will not put a face mask on when they have like La forte fractures and so on but it's maybe a good thing when you have uhm long and chest contusion where we don't want to be uhm on long term ventilation. Uhm or if you have a patient uh like where under cardiac we've put also on patients with heart failure and MI's which you can convert very easily. So you don't have to intubated them you can just put them on a non-invasive.
	I	*(Loss of data)* ...but rather inclusive.
	P	Inclusion ja. *(Short silence).* And then ja also just the indication before you put it on you must monitor the arterial blood gas and then also take the longs bilaterally, the respiratory rate and acces-, accessory muscles.
	I	Patient blood and muscles we've got. Ok. Thank you, so you've got all of that. Ok group three? I think I must use another colour.
	P	Ok many of the things they said we've covered. So it's actually

		amazing how we all think the same.
	Group	*(Laughing).*
	P	Ja you have that not this so we can now just improve on the assessment plan you've got there already.
	Group	*(Laughing).*
	P	Ok we started with something completely different. We said first you must assess the skills level of your staff and that and then...
	I	*(Loss of data).*
	P	...obviously the environment in which this non-invasive ventilation will be done. We also put that under planning because we couldn't decide where to put it but I think we should start there. See whether you have the staff and the equipment to do it.
	P	I just want to say we had the same query because we said the knowledge and the skills of the staff but we put it under implementing when you going to actually start, but I hear it's maybe a good suggestion to put it under assessment. Because we've also got that it must be...
	P	We-we put it under planning as well because we couldn't decide because you know actually you must assess your ability to do this first...
	P	Mm.
	P	...before you start with the patient.
	I	Ok.
	P	Ok and then we also had a history of diagnosis and so on and prognosis's. Uh especially where I come from the prognosis is a very-very big indicator but actually now a day's whether your prognosis is good or bad, you can get non-invasive because it's a, it's an additional thing they can do for the patients. So lots of the

		one…
	I	I just want to clarify this, what you actually saying is that if the prognosis is bad, in bad go for non-invasive.
	P	Mm.
	P	Mm.
	I	Yes especially if the prognosis is bad, they will go for, but it's all good. If the prognosis is good like in a pneumonia in the, in the acute, the first phase, that can maybe by short term by non-invasive prevent the patient from being incubated, they do it. But if the patient is a bad prognosis, COPD, are on home oxygen, we also do it because this is something we can do that's not invasive and it doesn't take much more. So the prognosis is important but it goes both ways. Good and bad.
	I	Ok.
	P	That's what you said ne?
	P	Mm.
	P	And-and also the age thing you know sometimes you'll have a patient that is too old. They do put them on non-invasive.
	P	Ja and that is what I wanted to say, age to us is not a, it's not a factor, unless you're too young.
	Group	*(Laughing)*
	P	Ok then uhm when we did the assessment further on we also went according to uhm systematically like they did. Uhm and we-we had a discussion on the Glasgow Coma Scale, because a patient with a glasco 14 can be combative sometime, so we decided to include the glasco and just say level of consciousness. He should be awake and he should be, he should comprehend what is going to happen.

		Just to make it easier because a DCS is a, it's nice to write it down but sometimes when it's 12 or 13 or whatever and the patient's not comprehending and he's not working with you. And the point is if he's not awake and comprehending we won't do it. All right. Then uh the respiratory we went according to inspectional pulsation, purcussion, palpitation.
	Group	*(Laughing).*
	P	Real nurses. *(Laughing).* Then we added diagnostics just the sister *(loss of data).*
	Group	*(Laughing).*
	P	So it's basically almost everything you've got, we've just put it under specific headings. Uhm, then on the diagnostics for assessment of the respiratory assessment we also used the blood gas but we said yes you will look at the oxygenation and the ventilation and also the metabolic values, but what we found a lot in practise is that that's not so important as long as the patients PH is normal. Peoples COPD's they have high SPCO2's but they have normal PH's which means they use to it so it's fine. We only start ventilating then when it starts changing the PH of the patient because then it's abnormal.
	P	Ja.
	P	So, because I think with these patients especially if you look at the book, the things we written down there at the bottom, it's going to be difficult to say the PO2 must be this, the CO2 must be this...
	P	Ja.

	P	Ja.
	P	...it's not gonna work so but now the patient's still stable according to his blood gas, the PH then it's fine, then he doesn't need it but once it becomes unstable we have to do it. Uhm, ja. Ok then we have the, we have a general thing. We didn't say cardio vascular whatever we have one which is general. General things to assess and consider before you do this-this. Things like patients with facial abnormalities, not just fractures, wearing false teeth that cause leaking *(grinning).* And naso-gastric tubes that causes leaking, things you have to consider. Uh these patients you must decide whether the naso-gastric tube is important or not and if you can live with the leakage that you have with that or not. And that's that I think.
	I	Ok thank you for your input group three. Group four?
	P	I can say we honestly have almost nothing to add since you've covered everything but we've got a, we've got a theme for this whole thing; you have to be awake and willing.
	P	Mm.
	Group	*(Laughing).*
	P	So once you getting the GCS with approaching with the 14 and 15 absolutely qualifies for this but as you said also now you have to assess the operation and decide for yourself. So uhm I think a patient with COPD is absolutely included.
	P	Mm.
	P	They flair very well on CPAP.
	P	Mm.

	P	On CPAP.
	P	Mm.
	P	Uhm another thing also these patients they don't only need oxygen, sometimes they need the P too so that's something to keep in mind also ja. And then with the assessment of the respirator's everything you all said. Nothing to add I'm sorry. And then one other thing you can remember is you can educate your family also...
	P	Mm.
	P	Mm.
	P	...and uhm lot of these patients have got acne as well and you get the uhm acne CPAP machines you take home so if they have the funds...
	P	Mm.
	P	...you can tell them about the option of getting a machine and taking it home. Very beneficial to your patient.
	P	Mm.
	P	And that's all for now thank you.
	I	And the ratio?
	P	One to one.
	P	One to one.
	P	These patients are a lot of work.
	P	Ja.
	P	They are. You have to hold their hand, comfort them, speak to them, they really are.
	I	Ja that's if you've got staff.
	P	Ideally but it's not gonna happen. Ja.

	I	Ok ladies let's start with group one maar again.
	P	Ok, wie gaan volgende ietsie sê?
	P	We do not differ from alcohol and drugs, but when you look at if the person is been picked up from street with alcohol and toxicity, you know if he's externally, he exploits himself from home, but if it's a person, a known alcoholic treatment only starts after 24 hours. So they are excluded after 24 hours but if it's a short term thing, ja 12 hours or 24 you include them because you don't want to intubate them.
	P	I think that's a real good point that you've made.
	Group	*(Loss of data due to overlapping group conversations).*
	P	The problem is when they start *(loss of data)* but I hear what you saying. They should get well.
	I	Ok do you mind to actually now go through this and reach consensus. Because that will be easier as it stretch.
	Group	*(Loss of data due to overlapping group conversations).*
	P	Rather all four.
	P	I think...
	Group	*(Loss of data due to overlapping group conversations).*
	I	Ok.
	P	Nee ek is nou klaar gepraat, dis nou jou beurt.
	P	Dis reg.
	P	Like quick now. *(Laughing).*
	Group	*(Laughing).*
	P	Dis nou jou beurt. Asseblief praat.
	P	Ok uhm what we included in planning was to get consent from the patient as well as the family. If you have a calm enough patient then non-invasive ventilation will work better and then uhm you

		have to have your baseline AGG's, test x-rays, your uhm vital signs, all of that need a base so you can know whether you going up or down or just going straight forward. Uhm we said the time frame in planning as well because you want certain outcomes at the end of the day. Uhm and it must be patient specific, not all patients will have the same non-invasive ventilation so uhm for that we said you need to do regular OBG's. Sample two hour, four hourly after the initiation of the non-invasive ventilation to see whether your patient is progressing as you would like to or whether you need to do the necessary *(loss of data)* to adapt better. And then also your assessment *(loss of data)* volumes for your patient. And then the time that uhm non-invasive is used. To some patients it will be beneficial to use only 20 minutes every hour, others will take, needs more, two hours and a little bit of rest in between. So that's why patients specifically you need to plan their activities around your time that you off from the ventilators by eating and drinking all of that. And then of course you have to plan your equipment. Your mask need to be fitted according to your manufacturer's prescript or indications, ag...
	P	Specifications.
	P	...specifics. Uhm the right mask for the right patient. Uhm the humidifier that needs to be used with the specific ventilator and then your settings. Uhm starting on the FO2051 and then gradually

		decreasing as your patient is coping with the, with the ventilation. Uhm your P as indicated by your doctor. Uhm we made a suggestion that if you start with P and pressure support you plan to increase it gradually. Some patient doesn't, uhm some patients don't cope very well if you start with a high P, high pressure support. They feel uncomfortable, they get anxious so rather start with a P and pressure support low and the gradually increase it up to their comfort zone where they, they not fighting it anymore. And then positioning your patient. *(Loss of data),* adequate rest times, is he sitting in the chair, is he in bed sitting up. Uhm and you must just plan according to your specific outcomes.
	I	Ok thank you. Group two? Ag group three. Are you blue?
	P	Ja we-we...
	I	Blue.
	P	If I listen to what she just said we are, we have actually then implemented and planned some of this stuff, some of what they've got is in our implementation phase so a lot of it is the same. The only thing that we can really add is we said if you plan to use non-invasive ventilation, you must plan to have your risk factor management in order like for instance where you put graniflex on special, specific pressure areas to prevent the patient from getting pressure sores, prevent it, you not wait till it happens. Uh we also said the x-rays, we also said about the blood gasses uh but we though here we can plan maybe uhm you, look every-every

		uh pathway in different hospitals is gonna have their own time frames here, but like for instance if you do it in your hospital you should say blood gasses four hourly or two hourly or something like that. Chest x-rays daily so that you can have a, I mean it's, this is like a guideline almost. They say it mustn't take long but ja. Ne? Then we also just added you must always have a plan B as well. If plan A is non-invasive and it doesn't work, what will plan B be? So here the prognosis once again comes in to play. If plan A, oh, B being to intubated or is it that you gonne just let the patient go on his own way or whatever. So you must have a plan B. I think the rest is actually said. Some of the things we said like the-the settings and the mode we've put under implementation one. So, so that's what I have under planning.
	I	Group two?
	P	Ok uhm also basically the same as what the other two groups said. Uhm we started with the investigations which we are going to do baseline, chest x-rays, bloods, uhm ABG and ECG's. Uhm then uhm for the equipment you have a non-invasive ventilator in place because not all ventilators can do non-invasive. Uhm and then also the type of mask that you are going to use, uhm as far as I know there's three types of masks on the, on the uhm...
	P	Market.
	P	...on the market. Uhm so the type of mask that you going to use and which one will be uhm mostly available to you. *(Soft laughter).* Ok and then also in the uhm, we have also said about the consent

		but not only for, from the patient but also from the family and also what was important to us is the continues communication and education of the family members plus the patient himself if he is competent to or if he is awake enough to hear you. And then also what type of non-invasive you are going to use. If you only going to use a P mask which is going to give you only the P from the morph if that's the only thing you need or are you going to use a ventilator which you can, which you can use different kinds of modes and uhm different kinds of settings. And then obviously you have to plan if the patient is co-, co-operative enough to go for the non-invasive.
	I	Ok. Group one?
	P	Ok, we also uh basically have all those components. Uhm the only thing that we, we actually also even in our group we had different opinions and I think it will be something new to raise to the group. Although we know they normally say that you should start on a 100% oxygen, we felt that actually maybe we shouldn't start on the highest FO2 because if the patient then uh maybe deteriorate or then you've got nothing to go to. If you start on 100 maybe they would have coped on 60.
	P	Ja.
	P	But I don't know how the rest of the group feels.
	P	Ja.
	P	We also.
	P	I saw...
	P	But we also felt at the end that you shouldn't always start on a

		100%.
	P	Ja.
	P	And maybe it's you know look at the patient specific but if you don't make it sort of a normal we start on a 100%.
	P	I think that's where the baseline ABG come in. You have a baseline or the ABG at the PO2 then you can start on the lowest *(loss of data)*. Then you basically know you know.
	P	I think what I've discovered now; some people start off with a high P and high pressure support, that's what they want the patients to start as from that. What I've sort of discovered that by the time I've, by the time we've started and now I'm asking the staff about non-invasive, patients already desaturating and they really battling. So start them on a low P and a low pressure support...
	P	Ja.
	P	...that's not gonna really help them in the first five minutes, that's why we put them on a 100% because everybody stresses about the saturation on the monitor for some reason. So to get that going and then it takes you five, 10 minutes to get your pressure support to work to where it wants to be.
	P	Ja.
	P	So I just think it depends on your hospital what do you start with. Do you start with heightened pressure support or you start with it low and get to where you want to.
	P	And then the pressure will rectify it too.
	P	Rectify it too.
	P	I think you should look at the complications of a high FIO2, its worse on the heartbeat especially on a non-invasive.
	P	But then again it's for such a short time. Oxygen on maximum...

	P	Mm.
	P	...then you going to take it right down to 43, not leaving them on a high FIO2 for the whole hour that they are on non-invasive for that hour, just for the first five, 10 minutes. And as you bring up your pressure supporting BP you need to reduce...
	P	You need to reduce your FIO2 and I think that's very important. Sometimes they leave them on the high pressure...
	P	Considering the side effects of my FIO2.
	P	Mm.
	P	Do you think there's a difference between non-invasive FIO2 and...
	P	M-m.
	P	Hu-u.
	P	No.
	P	Depending on how fit, how well the masks fit...
	P	Ja.
	P	...but uhm...
	I	All right.
	P	That's all we had to add to...
	I	That's all you going to add.
	P	...the rest we also had the same and we also said you know really big emphasis is as they said is on the patient as well as on the family you know. Information uhm...
	P	And education.
	P	...education ja that was a nice word, I like that.
	I	Nice.
	P	Mm.
	P	And the-the dehumidification that all of you actually said because sometimes we see that they only put the filter on and they don't

		humidify. But we also, well everybody so far said rehumidification, which is also important to us.
	I	Is anybody, does anybody want to add to the implement- ag to the planning? Now we go to implement. Shall we start at group three? And then we can start at group four for the last one. Ok group three, what have you got for implementating?
	P	Ok the implementation I also say our implementation and planning phase is very overlapping with some of the other groups. Uhm once again we said before you start you must go and you must make sure that you have patient comfort and decide on how to position the patient. And you said something like semi *(loss of data)* is not *(loss of data).*
	P	Ja.
	P	Basic things like that. Uhm we said you must actually now fit the mask, make sure it is the correct size to reduce your leakage. And then we-we put the modes here. I don't know where the modes must be. We said here you must now choose your mode and according to the mode you will have to set your settings. The settings are different on a different type of mode. And then we said uhm now this can be implementation or planning. Most of these patients are on nebulisation therapy so you must be able to implement that as well. Obviously you must plan it well, decide when you gonna give it and what's the time frames for that, two hourly, four hourly. I think that will go together with the planning of what's the time frame for the non-invasive ventilation.

		Then we also said for our other implementation that you must have the physio's involved for at least daily physio therapy for these patients. And then if you have to suction these patients it must be PRM. And you can add the rest. Group two.
	Group	*(Laughing).*
	P	Thanks I. *(Laughing).*
	I	Ok we going now where? Group two apparently.
	Group	*(Laughing).*
	P	Ok we also said under implementation the modes of the ventilation, your percentage of oxygen and your-your settings for the ventilation and then we also bring in some medication like uhm Analgesics and uhm maybe a little bit of sedation, Analgesics but only in small amounts and with the medication you must know all the patient allergies. And before you can administrate anything you must know the hemodynamically status of the patient because if your blood pressure is low you obviously not going to give him anything that's going to make it worse. Uhm then we also said that you must just evaluate uhm the arterial blood gas continuously. Uhm and then uhm especially when you gave him any of the medication you must continuously uhm monitor his glasco-coma scale uhm and evaluate for over sedation. So uhm and then always keep your patient calm and reassure him of his condition. Uhm as well as the family. Uhm and then the multi disciplinary team is very important for non-invasive patients like

		the physio therapist, the dietician, the nurse, the doctor, the pharmacist, the radiologist, the laboratories, spiritual needs like a pastor or a dominee or whoever and then the case managers. And then I also just said there uhm you must just continuously monitor all his uhm, all the systems like cardiovasculary, urinary, uhm mostly this patients have uhm urinary catheters because they can't go up and down on the bedpan or to the toilet. And then you must especially monitor for infections at the urinary site uh catheter.
	I	Ok.
	P	Group one.
	Group	*(Laughing).*
	P	Ja.
	P	We also like the other group some of the things ja is that we also writ, wrote it under implementation but we also realized you first have to plan. Like you have to plan for mouth care, pressure cares specific pertaining to the mask and also as we said also to plan for specific rest periods and how we have to implement that planning of the rest periods, the mouth care, the pressure care specifically pertaining to the mask. Uhm and then also just we-we said the same aspects from uh you know the setting of the ventilator uhm but also specific that it should be specific, here you have to decide and implement then the specific ventilator settings but also then the alarm settings specific for this patient. What is acceptable uhm pressures excreta for this patient.

		And the one thing we also uhm actually said when you implement, when you really now initiate your ventilation, it's for the uh-uh what we've actually seen by experience in our group is that the patient actually does much better when you start off just holding the mask with your hand. And just first see that the patient is coping and that you can sort of feel that he is all right now before we literally you know strap it and make it even more tight. Cause they do get very anxious and will pull everything together. So that's just something in the implementation you know, hold it with your hand and make sure they are comfortable and then you can you know strap it to the face. And we actually in this stage we-we included the-the knowledge of the person or the skills that is needed but I also think we have decided then to put it under the assessment that the person who is actually going to initiate the ventil-, the non-invasive ventilation should have, but we put that under assessment. But like I say some of the things are overlapping but we also feel that is important that the one who really implements or initiates that they should have the knowledge and the skills. And also like they said the specific observations and all the rest we also have. The physio, the annulations and also here we actually said what that group said of it must be patient specific. You know what their specific needs are and plan it and implement it

		according to that. And that's all that we have to add.
	P	What about the sensitivity and the *(loss of data)* flow?
	P	Ja we ja that actually comes under the setting. We also said as at the *(loss of data),* to the P, the pressure support, the sensitivity in the P flow, amend the alarm specifically for that patient.
	P	Can I just add something? I don't know if it's going under planning or implementation. These patients nutritional status, especially because they on the CPAP they don't eat like they should eat so I think it's also important to look at the nutrition.
	P	Or maybe you should plan specific…
	P	Ja, nutrition.
	P	Ja.
	P	And optimal fluid status.
	P	Ja.
	P	Ja I think on nutritional cause some of them will cope you know taking off the mask and allowing them to eat but some of them just don't cope when you take off the mask and some of them also don't feel like eating. So I think that is a valuable point, the nutritional status.
	I	We've got the fluid status in assessment.
	P	Ja. So we have that ok.
	I	So we'll put here food status. *(Short silence).* Is jy nou klaar?
	P	Yes then I think its group four.
	I	Ja, group four can add on to that.
	P	We don't actually have anything to add on to that. Everybody's already said it. But I've just got a question to ask. I'm not sure if it's

		already been discussed. Somewhere along the line you need to look at, you've decided that you have to do non-invasive but if you've got a 350kg patient, we don't have a mask big enough to fit him. Because we had a patient who was intubated but because his neck was so big the ET tube kept on coming out so he needed non-invasive but the mask didn't fit him and the head strap didn't fit him either because he was too big for it. So that's somewhere ells.
	P	Have you ever tried the full face mask?
	P	Uhm look with a state hospital that's a question mark.
	Group	*(Laughing).*
	P	The thing is though the-the straps are not big enough...
	P	Big enough.
	P	Big enough.
	P	...to-to go from the back of his head to keep the mask on to his head. Never mind the mask not being big enough.
	I	The question will be whether he is suitable for ICU.
	P	ICU.
	P	Well he is in your ICU.
	P	Na...
	P	No I don't...
	P	So I'm looking at it from an IC point, he is already in the ICU. He's been there...
	P	I think you can put that under uh your assessment.
	P	But if he doesn't, if he doesn't fit the equipment you've got, obviously you can do non-invasive.
	Group	*(Loss of data due to overlapping group conversations).*
	P	Obesity is the reason your equipment doesn't fit in that specific prognosis. *(Laughing).* It's like you can't scan him either whether

		you want to or not, the table doesn't fit.
	P	Ja you can't scan him.
	P	So he doesn't get the scan, so at this stage he won't be ventilated.
	P	But that is a...
	P	Tracheotomy.
	Group	*(Laughing).*
	P	Say you do actually get a non-invasive mask that looks like a thing that you can dive with.
	P	Ja.
	P	They go over the head.
	P	Over the head.
	P	But I'm not sure if we even have some hay.
	P	No there is one available, the Netcare Hospital use it *(loss of data)* but it is very expensive and the medical funds, the aid they cause a problem.
	P	It also depends what-what, as I say I think someone mentioned this, one of you guys mentioned it depends which company supplies your hospital with masks.
	P	Ja.
	P	Cause I know our company has got three sizes and that's it.
	P	*(Loss of data).*
	Group	*(Laughing).*
	P	I just want to find out if this includes laryngeal masks?.
	P	No.
	P	No.
	P	No that's invasive ..
	Group	*(Loss of data due to group overlapping conversations).*
	I	That's a good question. All right. Whether-whether the laryngeal

		mask is invasive or non-invasive. Ja.
	P	That can be debated.
	P	Ja.
	Group	*(Laughing).*
	I	Ok so we go on to evaluating now. All right, let us go for this group who has not yet been put in note.
	P	I will just say the bare minimum, the rest can add. *(Laughing).* Otherwise they don't have anything to say. I just say that we have to evaluate continuously all the systems. Uhm systems, respiratory, uhm ABG low *(loss of data)* PH reading better on the settings that you have. Uhm the chest x-rays, the less infiltrations, uhm is the airway uh air in better, uhm the LOC is he more awake. Say for instance he was on non-invasive because high POC, PCO2, is he more awake now or is he still very sleepy. Uhm ventilator, uhm all the settings that you have done uhm after the uhm ABG. Uhm and decreasing or increasing of oxygenation. And which is very important to us is the anxiety. Is the patient still anxious, is he calm and then which is very-very important uhm most of the patient's uhm because of the uhm non-invasive they get a little bit of gastric reflux and they uhm are getting nauseous and vomiting. So you must just very closely observate him for aspiration. You have to have clear masks.
	I	Ok. Group one.
	P	Group drie.
	Group	*(Laughing).*
	P	This is like musical chairs.

	P	Uhm I think the reason she says she's just gonna mention the bare minimum is because I think by this time we all have the bare minimum.
	Group	*(Laughing).*
	P	Ok we just said evaluation it's-its very uhm overlapping with the whole process actually. You evaluate right through you know. Not just evaluate at the end. That's why it includes things like blood gasses and chest x-rays. We-we which we already mentioned, just to see whether it's now better or not but we've done that in the implementation as well. So and then we said hemodynamic evaluation and its systematic review. Since we assess systematically we support we should review systematically and at the end just to see if what you found there is better or not. Uh ja.
	P	Dis 'n mooi word.
	P	Dis nou maar julle beurt.
	P	I've got only two things to add.
	I	You mustn't become lazy hay.
	P	I'm not lazy but that's all I know.
	Group	*(Laughing).*
	P	Remember to evaluate your safety. Re-humidification can burn your patient. Remember to set it to non-invasive and not invasive. And evaluate for pressure sores, I think she said it in the planning or somewhere.
	I	Just, just say that again? How to check the re-humidification and?
	P	What was the other word...
	I	The setting?

	P	Ja.
	P	When it's non-invasive the intubation...
	P	Ja that and also for burning.
	I	Ja.
	P	Ja that and pressure sores.
	I	Pressure sores. Ja.
	P	Ok and then the next thing don't forget to evaluate your patient's knowledge about what's going on. If they understand why we do it and the importance for co-operating. Thank you, group one.
	Group	*(Laughing).*
	P	Ok we said almost the same as all the other groups. It's just one thing that we want to add; is with the evaluation you can do your uh RSBI which is your rapid shallow breathing index where you take a patients tidal volume, the patient's own tidal volume on the ventilator...
	I	Shallow?
	P	Breathing Index.
	P	A breathing index.
	P	RSBI.
	P	Daarsy.
	P	Yes.
	P	...and divide it by, by the oxygen uh and then you get, it should be less than 200...
	P	Tidal divided by oxygen.
	P	...patient being able to, if it's more than 200 to 300 it can indicate ARBS.
	Group	*(Loss of data due to overlapping group conversations).*
	P	No it's Rapid Shallow Breathing Index. You take the tidal volume

		and you divide it by the FIO2.
	P	Ja.
	P	Ja FIO2.
	P	And then if it is less than 200 it's actually quite the indication for...
	P	By rate.
	P	By rate.
	I	Gaan nou aan by rate.
	P	Hallo. Rapid Shallow Breathing Index.
	I	Rapid...
	P	Tidal volume divided by rate.
	I	Dit moet wees.
	P	Divided by rate.
	I	Ja by rate.
	P	Sorry ja dit is rate. Ja.
	P	Ja.
	P	Ja.
	I	Divided by rate.
	P	Ja.
	P	Ja.
	P	It's right, sorry. Ja ok and then what we also said is that uhm when your patient is not very co-operative or they, they battle a lot, you, the sensitivity is really important. You must put it on the most sensitive uhm setting. And then the uh what is the other one, o ja, the peak flow. You can decrease the peak flow because then it doesn't push that amount of air in too quickly. I think that's all.
	P	Mm.
	P	It's all.
	I	It's almost like special consideration.

	P	Ja.
	P	Ja.
	I	Can we call it something like that. *(Silence).* Because I think even the white would be special considerations.
	P	Ja.
	P	I've got another idea; I often end up in an argument with the doctors they ask for CPAP. Cause we need to define the one with the tube is CPAP and non-invasive ventilation. As far as I understand it, CPAP is where you given the mask and they just got to keep with the mask and you connected to a blender. Non-invasive ventilation is where you give them pressure support and the ventilator.
	P	That is right.
	P	Because that is a big...
	P	Ja.
	P	So you still ask him to go for non-invasive or not?
	P	There's a CPAP where you just gonna click and they've got a mask connected to the oxygen source but the ventilators do have a mode you call CPAP. So we must also be careful, CPAP and non-invasive...
	I	So actually we should define it. Probably.
	P	What, what...
	Group	*(Loss of data due to overlapping group conversations).*
	P	Because I don't know, in our hospital if you put a ventilator...
	P	Uhm I was under the understanding that as soon as you add a pressure support it's called BPAP and if it doesn't have pressure support it's called CPAP.
	P	Ja.

	I	Invasive and non-invasive.
	P	Ja.
	I	That's what she's saying.
	P	As soon as a patient is intubated it's called invasive ventilation and not BiPAP.
	P	Ja dan is dit ja.
	P	We need to define all these terms, modes, tidal.
	P	Hasn't it been defined already?
	P	I think what you'll do is you'll have to define it in front or at the back of the uhm, of the uhm-uh the pathway. Has to stipulate what is meant by non-invasive ventilation. But that you will do, define it and send it back, rotate it back, I think that will be the easiest because you can even see amongst us it's a problem now.
	P	Because I don't hear you saying you need a BPAP, you keep on adding the rate to it uhm...
	P	Ja we...
	P	Ja.
	P	And some ventilators call it a spontaneous time mode, others spontaneous...
	P	Mm.
	P	Or is it a ... just between different ventilators?
	I	So I think she will have to define it for her specific ventilator in her specific setting, uhm setting.
	P	Mm.
	I	What do they use, what is the settings they use and how is she going to define those specific settings.
	P	That will be important.
	Group	*(Loss of data).*

	P	I think what is also very important is the HP, to keep that optimal by doing the uh saturation...
	P	*(Loss of data).*
	P	Ja.
	I	There's something ja. All right what I think we should do now, we should go through each one and then decide actually which should go where and who actually agree on the mutual things. So uhm shall we start at the beginning and I'll go through it and just say yes or no.
	P	Is that the time already.
	I	So I think she will have to have a page defining the consents, defining non-invasive and defining the different settings and maybe the different alarms. What do you think?
	Group	Yes.
	I	She uses...
	Group	Mm.
	I	...so you will state the ventilator, state the settings, state the alarms.
	P	Some ventilators might incorporate non-invasive *(loss of data)* non-invasive pressure ventilation. Other ventilators uses CPAP pressure systems as a non-invasive so it's very...
	P	Ja they do.
	P	Cause every single ventilation you do actually non-invasive in every *(loss of data).*
	I	So I think she will actually have to define that with you know the setting. The first thing is that we should involve the patient and the family in this process. Do we all agree with that?
	Group	Ja. Yes. Ja.

	I	And do we all agree that it's actually a continuous process of education, reinforcing and evaluating. So the patient and the family both will go through, right through. Do we all agree?
	Group	*(Silent).*
	I	Then we've got for her what is exclusion criteria and here we actually did differ and I think we should actually now come to a consensus. Here we first said exclusion criteria is a myocardial infarction, uhm congestive heart failure, asthma, COPD, aspiration, uhm facial injuries and we in the end said uh fractures or injuries, abnormal uhm false teeth or abnormalities on the face and then the NG2. So let us first then say about acute myocardial infarction, should it be in or should it be an exclusion criteria?
	P	Right we feel there if a patients got pulmonary oedema, because they said then if you put him on non-invasive it actually increases the strain or the-the you know it actually...
	P	On the myocardial...
	P	...ja the myocardial so then it increases the-the-the work load. Uhm I think if you maybe got uh angina then and you need that then you can include it.
	P	So it's got more to do with acute myocardial infarction where it's got a problem with the myocardial oxygen supply.
	P	Ja.
	I	Yes?
	P	*(Loss of data)* private hospital or also includes previous myocardial, anything that puts extra strain on to the myocardium. So it's not

		only acute now but previously as well.
	P	Ja.
	P	I'm gonna throw a "klip in die bos".
	I	Yes?
	P	In a mycosis/hypoxia doesn't that happen as well?
	P	Why do you *(loss of data)* raise it because it's usually patients that's struggling (loss of data) for something. So either you gonna tube him non-invasively where hypoxia is going to be strain on the heart as well. So you now have to make a decision.
	P	But I think there's far less injury not only strain.
	Group	
	P	...acute phrase but previous once, I don't know. I think that's a personal thing.
	I	So we then look at the acute myocardial infarction as a possible exclusion?
	P	I think the researcher can go look at the literature and...
	P	Ja.
	I	And actually confirm that and then for previous myocardial infarction also uh confirm it all out and then come back to us with the final. Uhm congestive heart failure will be more or less the same uh scenario but you think it should be excluded?
	P	No.
	P	I don't think so because most of your CTF patients has COPD and those go hand in hand and CPAP really works well for COPD patients.
	P	Thank you.

	I	Ok. So we will exclude it but the researcher can then still go back to the literature and see whether they exclude it or not. I think this is for everything basically, going back to the literature and confirming what we think and what we use in the clinical setting based on our experience because we can see how our experience varies a lot. Uhm asthma, COPD? COPD definitely. Inclusion, exclusion?
	Group	Inclusion.
	I	Inclusion ok. Asthma?
	Group	Inclusion.
	I	Inclusion. So I'm going to...
	P	I think it also depends on the severity of the asthma.
	P	Ja.
	P	Patient specific.
	P	If its acute asthma they won't, they won't, they won't do well. So I think if it's a stable asthma we can say ok...
	P	Not in acute.
	P	Ja.
	P	I think the acute asthma we can...
	P	Ja.
	P	But maybe asthma is an exclusion one because it's a severe case.
	P	Severe case.
	I	That is what they've stated.
	Group	Ja.
	I	Ok. COPD exclusion I think we are in agreement.
	P	Inclusion.
	P	Inclusion.
	I	I'm just writing all of this will depend on severity.

	P	It's again patient specific.
	I	Patient specific.
	P	Ja.
	I	Ok. Aspiration, with a GI bleed, abdominal distention?
	P	No.
	P	I don't think so.
	I	Exclusion. And uh facial injuries, fractures, any abnormalities, false teeth, you agree?
	P	Dis onderhandel baar.
	P	I don't think it's an in or exclusion. You must be able to manage it.
	Group	Ja.
	I	Ok so this can be one of the special considerations.
	P	Ja.
	I	Special consideration, false teeth. And the nasal gastric tube?
	Group	Special.
	P	Special.
	I	Special considerations because that *(loss of data)* the *(loss of data)* reduced then about that...
	P	You can get special adaptors that can fit over the NG tube so it seals the NG tube with the mask or like we use tape.
	Group	*(Laughing).*
	I	Or is there any other things, I mean other groups that know something different about nasal tubes?
	P	Some, some of the masks, more modern masks actually got a special uh hole on the side where the NG tube fits into. So you disconnect it, feed it through there before you put the mask on.
	P	I mentioned the naso- gastric tube, it's almost the same as the *(loss of data)* CVP line, you have to decide, do you need it or don't you

		need it. If you can go without it you go without it but if you do need it, leave it there. Then you must just make a plan for the, for the loss of air.
	I	It will be then a special consideration.
	P	It is a consideration.
	I	Ok then. So now, first of all we uhm have to look at the history. You know now the exclusion criteria, uhm we know now our staff, I think. We need knowledge, skilled staff and I think we've had consensus that this should fall into the assessment. Do we all agree?
	Group	Yes.
	I	Before we actually start the staff, the environment...
	P	What are we talking about now, I'm not sure?
	P	When you do a non-invasive properly.
	Group	ICU.
	P	Or high care.
	P	That's what I mean by environment, it's like your critical care type of environment, ICU or high care but not the wards.
	P	So it's specifically critical care environment and not the ward.
	I	Ok and you will agree on one to one.
	P	Ja.
	I	And that it's labour intensive.
	P	Mm.
	P	Yes.
	Group	*(Short silence).*
	I	Ja?
	Group	Yes.
	I	Sê mooi hard laat ons hoor.

	P	And sometimes these patients are more labour intensive than the sedated and paralysed...
	Group	Ja.
	P	...and ventilated patient and that I think is something that people don't think of because they-they, these patients are low stream. You look at specifically in the, in the, how they rate them. They are rated as a high care patient where they are much more labour intensive than a sedated paralysed patient. So they are very-very labour intensive.
	P	So they should be a one to one ratio.
	I	And the next thing we are going to go to the history, what they should obtain. Uh the age?
	P	Mm ja.
	P	I think age can be, you can also put under special consideration...
	P	Ja.
	P	Ja.
	P	...because then again, age, age as we have seen is a special consideration. It will all depend on the patients specific needs, the underlying pathology, the environment. So I don't know about the others but I think we can actually put age under a specific cons- or under a special consideration.
	P	Dankie I, doen jy daai?
	P	Ja.
	P	Dis nice.
	P	Moenie worry nie.
	I	Ok special considerations ok uhm age. What about hemodynamic unstable, I'm just thinking, should that be under exclusion? Where the patients hemodynamically unstable?

	P	Yes.
	P	Ja.
	P	Yes.
	I	Rather than putting it under history? Exclusion or history?
	Group	*(Short silence).*
	P	But you know what we also spoke about again I think it depends on how hemodynamically unstable because maybe the patients got a little bit of dysrhythmia but it's due to the hypoxia.
	P	Mm.
	P	Uhm but I think...
	P	*(Loss of data).*
	P	Uhm but I-I-I, we also felt patients that are really, where they are hemodynamically unstable, on very being severely hypertensive or...
	I	Ok so it would be due to another cause.
	P	Ja.
	I	And not due to the hypoxia.
	P	Ja.
	I	Would that define it?
	P	Yes.
	I	Maybe like septic shock...
	P	Ja-ja.
	I	...so it's something ells, not caused by hypoxia.
	P	Ja.
	P	Ja.
	P	Ok so then I think that will be the inclusion.
	I	Ja that will be...
	P	Ja.

	I	Sorted that one out. Ok, uhm here we must look at the underlying uhm pathology. Uhm specifically pertaining to the longs I think because it's the one we are looking at. And this goes within, with the uh exclusion criteria. Is there anything you want to add there?
	P	I don't know how they feel but uhm one of the, I don't think exclusion, I think inclusion. One of the patients we do non-invasive a lot, one of the patients is already at home on oxygen therapy. Because those are the ones you really don't want to intubated, you can do non-invasive.
	P	Mm.
	P	So that's uh additional question they must ask are you already on home oxygen therapy or not. That's exclusion for intubation in our hospital.
	I	Ok.
	P	Can we also maybe say that uh-uh-uhm a special consideration or should be underlying pathology are you sort of uh too ill when you should be intubated...
	P	Are you...
	P	...or are you with-with the underlying pathology that for some people, I think there it should be a case of what is the underlying pathology and how, where are you diseased pro-...
	P	Yes, either in the beginning or in the end.
	P	...or the end and decide then should you be, are you too ill that you actually need intubation or can we give you the benefit of the doubt.
	I	Right, ok.
	P	Put it under special consideration or actually determining whether you should or not.

	P	Ja.
	I	Then *(sigh),* uh-uh important is to find out social history and I think smoking and alcohol and drugs was the big three things there. Smoking uh alcohol and drugs for the DT's and then specifically said 24 hours later if it was a known and underlying problem. But now if it was a motor vehicle accident for example and drugs related. So I think that depends on the time that the patients intubated but then we should know it.
	P	Mm.
	I	Is that how we all understand it?
	P	Ja.
	P	Ja.
	I	Should it stay there?
	P	Yes.
	I	As is there. Do we agree? Ons is almal moeg maar ons is amper klaar.
	Group	*(Laughing).*
	I	Ok. Durational illness and prognosis I think goes well with the OJ at home. So those three uhm are obviously then uh special considerations. Going together with that one. And I think we shall do that on it's actually one thing. Or one component. Now we going to the uhm systems orientated. Systematic assessment as you put it. Uhm the central nervous system, uh all of us uhm said uhm L and C, some of us referred to the glasco-coma scale, others want you to stay with the mental status. Now here the glasco-coma scale between 13 and 15 is that acceptable?

	P	I-I think what they said was actually good point. You have to have an optimal level of consciousness and to such an extend where you can co-operate and where you are actually awake. Well and willing she said.
	I	Awake and willing.
	P	Awake and willing yes.
	I	Awake and willing. So it's more about the mental status of the patient, the glasco. You can monitor it but it's an adhoc. Do we agree?
	P	Ja.
	I	So the mental status is really the thing that will guide us. The uhm sedation?
	Group	*(Silent).*
	I	It goes with mental status ne, so that is actually a component of the mental status. So are you awake and willing and even if you are sedated are you awake and willing.
	P	You'll win if you sedated me.
	Group	*(Laughing).*
	P	Yes.
	P	You and you hay.
	Group	*(Laughing).*
	I	All right so we actually look at those components together. Do we agree? And that is central nervous systems sorted.
	P	Ja.
	I	Respiratory system. I think we all agreed. Respiratory rate is important but there was something that said your respiratory rate can still be normal.
	P	Mm.

	I	It should not necessarily be increased.
	P	I think it's difficult.
	P	Ja it is.
	P	It's also patient specific. Especially if you look at the conditions we set into it by COPD and those.
	P	I think you must look at the-the res-, respiratory system as a whole and evaluate that as a whole and not just take one component.
	P	Ja.
	P	That will...
	P	Ja.
	I	Ja so we look at the, at the-the package.
	P	Yes.
	I	Instead of just looking at components.
	P	Ja.
	P	But what components are we going to look at?
	P	Ja.
	P	I know you can...
	P	*(Loss of data).*
	P	Ja.
	P	Yes.
	P	Ja.
	I	Accessory muscle usage.
	P	Nasal ...
	I	Which is nasal flair as well.
	P	Are we going according to sentry muscle use or we going according to *(loss of data)* or what-what are we, what do you call that?
	Group	*(Loss of data due to overlapping group conversations).*
	P	Does it not have respiratory distress signs?

Interview 1

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Name: Liezl Balfour

Time: 01:36:22

	P	Sentry muscles I think…
	Group	*(Loss of data due to overlapping group conversations).*
	P	Sentry muscles is one of the respiratory distress…
	P	Distress…
	P	I'm just thinking must we give it a big…
	P	No.
	P	…well there's most probably a professional name.
	I	Well she will get the jargon out of this.
	Group	*(Laughing).*
	I	We have underlying jargon here.
	P	Ok but the respiratory distress we can see.
	I	Accessory muscles, nasal flaring, sweating, anxious, all that. SPO2? Should this be included?
	P	If it's in the package yes.
	P	Yes.
	I	Ok this is the signs. Is there any other signs you would like to add?
	P	Let's see here what we uh got. *(Silence).*
	I	Uhm because I think uh if you look at the diagnostic stuff like S said it's something different. There you look at the arterial blood gas and chest x-ray…
	P	Mm.
	I	…but that's diagnostic so respiratory will go with the assessment and then the diagnostic. Uhm I your group has said purcuss, look, listen and feel. Shall we put it under those?
	P	Yes.
	P	That's what my group said but it's not all groups. *(Laughing).*
	P	*(Loss of data).*
	P	That's a suggestion.

	P	A systematic way.
	I	Ok so we will use the systematic way and put the sign and symptoms in there. Uhm where you look for respiratory distress, where you look for SPO2, but listening for respiratory uhm signs.
	P	I don't know what, the group must decide if we must keep it like that...
	P	One or two.
	I	Using the structure.
	P	Ask for *(loss of data)* purcuss and *(loss of data)* pain.
	P	Ja.
	I	Ok definitely then an entry should then be in *(loss of data).* Secretions?
	P	I think it should be an inspection really.
	P	Ja.
	I	Um pertaining the amount do you agree?
	P	Ja.
	P	Ja.
	I	Cyanosis, are we looking peripheral, central? Both?
	P	Both.
	P	Both.
	P	It's both.
	I	Peripheral and central. That I think is almost what we got up to. Then we go to diagnostic criteria. Chest x-ray, arterial blood gas? Arterial blood gas some of us said P at ratio, shunt AADPO2. Uhm others said PH will be the real important one and PCO2. So shall we say PH first then signs and symptoms of hypoxia and then of uhm...
	P	*(Coughing).*
	I	There's a patient, ask them.

	P	You want to increase before the PH changes because if your PH changes *(loss of data).*
	P	Think it's also maybe *(loss of data)* before your PH *(loss of data).*
	P	But-but-but we said there it is also patient specific. It's like the COPD patient has a high CO2.
	P	CO2.
	P	He is use to that so I don't know what, how high can he take. Some of them by 16, the others 18 then they start getting *(loss of data)* so I hear what you say but it's really difficult unless you manage different *(loss of data)* COPD *(loss of data)* for this one and I don't know.
	I	But we actually our own guide.
	P	Ja.
	P	Ja.
	I	*(Loss of data)…*for all types of patients.
	P	I only said that because I have the same things when we do rounds with students they can't understand the CO2 is so high, the doctor is going to tube, I don't know how to explain it to students that you know we teach them the normal *(loss of data)* that is when you start *(loss of data).* That the COPD patient *(loss of data),* he has high to start off with so for him it's normal. *(Loss of data).*
	P	So maybe you can look for us if it is with other patients the same.
	P	Maybe if you can go and look in the literature if there's specific something on challenges on PH.
	P	Ja.
	P	What is significant?
	P	What does the literature say?
	I	Ja because we are all using the same criteria.

	P	The same.
	P	*(Loss of data).*
	I	Cardiovascular I think the hemodynamic status is very important uhm and there we include vital signs and should not be related to anything ells except for then as we agreed, hypoxia changes otherwise. HP? Do we agree that that is important of the uh having an HP? The fluid status of the patient should be optimal do we agree? Everybody is saying yes, I'll say yes. Uh she said the SPO2, uhm SPO2 do you think that's important?
	P	Regarding HP ja.
	I	Ok we'll leave it over to the researcher. Uhm then we've got the special considerations which I'm not going to go through; I think we have discussed that. Now the one thing we have to decide is whether planning and implementation should actually be planning then your implementation phase...
	P	Yes.
	I	...should actually be the same thing and we can maybe call it planning and implementation to actually make it more easy or easier.
	P	Because those are the two things we all...
	P	Ja.
	P	...so I think that's standard.
	P	Think so.
	I	Because you actually now going to plan to implement. So what size, put it on. Or how do you say this J?
	Group	*(Soft laughter).*
	P	I don't want to say anything now *(loss of data).* Because when you

		start using the pathway, there's early *(loss of data)* and I don't want to say it.
	I	No-no, say it.
	P	Because she's sitting here.
	I	Ja no but that's fine.
	P	Ok then. When you put a patient on a clinicalpathway you use an inclusion criteria so this patient is COPD, this, this, this, then she's on the pathway) going that side. Now why going on that side, there is no one this side, which means the PH is still ok, uhm PCO2 is *(loss of data).* Ok now the PH starts going down then he moves over to this side *(loss of data)* so down, down, down. We cannot say planning and implementation overlaps it must be *(loss of data).* Planning on this side, it's a yes no and going down. Implementation goes over to this side, yes no yes no, ok, going to that side.
	I	Ja.
	P	That's how the case manager works.
	I	*(Loss of data).*
	Group	*(Laughing).*
	I	Ok I-I-I agree.
	Group	*(Laughing)*
	P	L is focusing on non-invasive ventilation so she must decide on what type of *(loss of data)* because the moment you start including, including a lot of patients it's going to be nearly impossible. Getting totally impossible to decide one *(loss of data)* for non-invasive patient ventilation.
	P	I think that's a good point. Excellent. Non-invasive ventilation anatomy is a wide…
	P	Trust me.

	P	Especially when you look at that, patients that's included.
	I	So a suggestion would be to populate or-or the population that you see most.
	P	Ja narrow it down.
	I	And narrow it and then focus on that patients.
	P	Because every patient's one will differ.
	P	Ja.
	P	*(Loss of data)* there must be a file for one for asthma, one for COPD, one for...
	P	That's possible.
	P	Ja.
	Group	*(Loss of data due to group overlapping conversation).*
	I	Ok we go on to implementing then uh...
	P	But-but can I, can I, onseker. If-if we decide ok this is the patient that is going to use non-invasive, so what is going to be the planning for this patient, what's going to be the implementation. So my suggestion is and I can be wrong, is let's write down everything that we are going to implement, ne wat gaan ons doen...
	P	Ja.
	P	...then according to that, your actions, you plan. In retrospect you-you, for each action there must be a plan.
	I	Ok.
	P	And then correlate the two like that. Is that uh...
	I	Will that be acceptable?
	P	I don't know L it's her study.
	P	Nobody says you have to plan first.
	P	Maybe we should decide together...

	I	Ja.
	P	...what-what would be the most appropriate, what would be the most user friendly ways to do it.
	P	You know I like the idea because if we now decide what is the implementation and then we can...
	P	Plan.
	P	...plan accordingly.
	p	*(Loss of data).*
	P	That's what I always do when I assess a patient, I write down what-what I'm doing with this patient. And sometimes in retrospect you say ok, but I plan to do it like this and now I've done it.
	P	Although you know you have to plan for it hourly or....
	P	Ja and you get your time, time frames for it.
	P	Because if you think in reality we never plan to implement, we do it.
	P	Ja you just do it.
	P	I mean where do you plan actually.
	P	Mm.
	P	Ja.
	P	Ja.
	P	Ja I support that suggestion.
	I	Ok so we are going to look at what are we going to do...
	P	Ja.
	I	...and then we plan accordingly.
	P	I think that's a good plan.
	I	We'll see what we come up with and she will have to come up with a structure and then we go from there.
	P	We might be confusing you more. *(Laughing).*

	P	I also think I'm also now *(laughing).*
	I	Ok so let's look at what we have to actually do. We have to do consent; we have to get consent from the patient, family or both.
	P	Ja.
	I	Is dit reg. We have to have a baseline data but we actually got it.
	P	Under assessment.
	I	Nice.
	P	Are you under planning now?
	I	Ja I'm-I'm going to put it there. Oh but this is what we going to do.
	P	I'm saying the first thing is the consent.
	I	So we have to get a consent. Is that agreed?
	Group	Ja. Yes. Mm.
	I	I know I'm under implementing but I think a lot of that if you going to put on the right face mask you know. Is that fine by you? So I'll just rephrase what you said there specifically if we doing it.
	P	Yes.
	I	Idea is we going to decide. Wat doen ons nou?
	P	The first thing that we are going to do, we are going to get consent. The second thing we are going to do we are going to get our equipment.
	I	Ok.
	P	Third thing, position the patient. Make the patient comfortable.
	I	Ok.
	P	Start by *(loss of data)* if necessary and you go on like that and then you do the whole thing, you finalize it and then you say ok we've done everything here, what was the planning behind this or how often must we do planning.
	P	And how often ja.

	I	Ok so it must be what-what are we going to do, the planning of what we going to do and uhm the time frame on it.
	P	Ja the time frame comes from the planning.
	I	With planning.
	P	Ja.
	P	So the implementation is as I see the actions and the planning is more specifically the-the-the time frames and that, ok, of that actions.
	P	Yes.
	P	Stem jy saam S?
	P	Well…
	I	Evaluation is the outcomes.
	P	*(Loss of data)* but you do not plan there for four hours, you plan for 12 hours, 24 hours *(loss of data).*
	P	But that we can put in our planning where you put your time frames there. Say for instance in treatment of the patient's uhm arterial blood gas within 72 hours, if the patient is still on non-invasive after 72 hours then intubation is necessary.
	P	*(Loss of data).*
	I	Of ventilation.
	P	Ja.
	P	Of ventilation.
	P	Ja.
	P	There's no things like inhalations or blood gasses *(loss of data).* So our biggest thing then must just be *(loss of data).*
	I	The actions.
	P	On *(loss of data).*
	P	But-but…

	P	You have to assess him 12 hourly or once in 24 hours or something like that but it's not going to influence what I'm writing on this non-invasive *(loss of data).*
	P	But-but can I ask something. If you do your actions at-at this stage in time, this stage in time, you have your actions that you can plan like I said we do it in retrospect, nothing, it's just making it easier...
	P	Ja.
	P	...to have our uhm structure, but with-with the evaluation that's where the pathway comes in. So that's under evaluation.
	I	Or maybe even though the planning does not form part of the pathway.
	P	*(Loss of data).*
	I	You get what I must do and what I must evaluate and if it doesn't fit that I must do something ells.
	P	Ja the evaluations is where the pathway comes in.
	I	Ok.
	P	A patient receives a cardio valve, a myocardio valve, now the prognosis for that valve, *(loss of data);* he doesn't come back to hospital for a year. He comes back and he has certain signs and symptoms but that is not part of the pathway. That is what he himself *(loss of data).* Part of the pathway is education. What you are going to give the patient is on another information data.
	P	Ja but that is to...
	I	But isn't that part of your planning and implementation initially?
	P	Ja.
	Group	*(Loss of data due to group overlapping conversation).*
	I	What we are saying is, I-I understand what she is saying. She is saying we are not going to give the detail; there will be patient and

		family education but what he *(loss of data).*
	P	*(Loss of data).*
	P	Say for instance ne, you have planned the non-invasive, you got your patient, you got everything that you need that's necessary, now what you initially do is you start at 100% oxygen, the settings and so and so and so. If that, if the patient is not improving then it's-it's no or yes.
	P	Yes.
	P	Ok, yes is part of evaluation then. Yes ok you continue with the same non-invasive settings. No; increase this and this and this.
	P	Ja.
	P	So it's part of evaluation then.
	P	Ja.
	P	That's where the pathway starts.
	P	Ja.
	P	I hear what she is saying; we mustn't get confused with the pathway with the nursing care plan.
	P	Nee ons doen nie.
	Group	*(Loss of data).*
	P	Ja.
	I	We've done it.
	P	We've done it.
	P	We've done it.
	P	We've done it so we don't...
	P	Nursing care plan.
	P	...so we not doing the nursing care plan so the pathway will say patient education, but how you going to do it, how often and with who is going to be in your nursing care plan not in the pathway.

	I	The-the initial thing will say inclusion and exclusion criteria.
	P	*(Loss of data).*
	I	Yes.
	P	Yes.
	P	*(Loss of data).*
	I	No.
	P	M-m.
	P	Ok so let us see what we have, we have consent, so then do we all agree, but with consent the family and the patient. That's included. Ok then baseline data?
	P	*(Loss of data).*
	P	Yes.
	P	This thing she is making, is it for somebody who is, we must decide whether you are going to use non-invasive or have you already decided I am using it now what am I going to do with it.
	I	You either going on or off.
	P	So we still haven't decided whether we are going to non-invasive...
	I	Well we have decided yes maybe no.
	P	*(Loss of data).*
	P	Yes.
	P	Ja.
	P	Maybe now the next step is now I have to do what I'm going to so the first thing now you say is consent. So you ask about it did you get a consent from whom. I don't know the family or the patient.
	P	Ok but what comes under assessment understand because we've got lots of detail there. You now saying you have *(loss of data).*
	P	We just actually...
	P	*(Loss of data).*

	P	Ja.
	P	What you've written there for instance under hemodynamic or cardiovascular system, we said uhm for instance now a patient has hemodynamic or include or it can be, it must be a hemodynamic stable patient or he is unstable due to hypoxia.
	I	You then can continue.
	P	You can continue. We are not saying now the blood pressure more than this or this, we just saying.
	I	We just saying.
	P	So this will just be broad things.
	P	Your assessment part, underneath assessment, that must be quit detailed. That's where most of your detail comes in.
	Group	*(Loss of data due to overlapping group conversations).*
	P	That part is for them now you come to the actual...
	P	Ja.
	P	But I hear what you saying, we getting a bit confused. When it come to the, to the actual pathway we, what I've listed here what we conclude on is we will decide on the order but what I've got here as number one is consent from either the patient or the family. That is the component that you going to put in.
	I	Ok.
	P	And the next component is baseline data, although that will depend but we not going to put values there. And then the equipment.
	I	You need a bed layer, a mask, a humidifier.
	P	The baseline data will be your assessment.
	P	Ja.
	P	But here we put in uh values or limits.

	I	Ok so under equipment we must decide the appropriate mask, the ventilator, the mask and the...
	P	Put that anyway now, you just said equipment, that's what I don't understand.
	I	What do you think?
	P	I think it's very important to-to stipulate what you must look out for because say, ek mag verkeerd wees, maybe it's too uh nitty gritty but there's some of the ventilators that has to be put on the mask or the tube, first when we put it on, the others like the Avios uhm temperature, uh the cascade itself must also be put on mask or the tube and if you put it on mask and the patient is intubated...
	P	Ja.
	P	...the temperature goes, it's really safety.
	P	Safety.
	P	It's really small detail but I think it is very important.
	I	So she will decide what they are using and then put that specific ventilators specific settings on what must be in place.
	P	Ja.
	I	For-for red flags. Is that fine uhm S? To put a red flag on.

Annexure D

Draft clinical pathway development

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

D.1

Phase 1: Draft clinical pathway

D.2

Phase 3: Participant feedback and evaluation

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Clinical Pathway for Noninvasive ventilation

Abbreviations used in this clinical pathway:

ABG	Arterial blood gas
BiPAP	Bi-level /Bi-phasic positive airway pressure
BP	Blood pressure
CXR	Chest x-ray (portable)
FiO_2	Fractional inspired oxygen
GCS	Glasgow Coma Scale
HR	Heart rate
PEEP	Positive end-expiratory pressure
RR	Respiration rate
SpO_2	Peripheral oxygen saturation

ASSESSMENT

Baseline vital data (RR, HR, BP, GCS, SpO_2)	
Patient history	
Allergies	
CXR	
ABG	
Special considerations	

PLANNING

Clinical diagnosis of ARF
(Tachypnoea, cyanosis, hypoxia, hypercapnoea)

↓

Confirmatory studies (CXR, ABG, Routine blood tests)

↓

IMPLEMENTATION

GCS>11

↓

- Explain procedure to patient
- Elevate head of bed 45°
- Fit mask
- Patient “awake & willing”
- Continuous monitoring of vital signs and level of consciousness
- Establish patent IV access

GCS<11

↓

Consider endotracheal intubation

Ventilator settings:

- Mode: BiPAP
- FiO_2 : 50%
- Pressure support: 8cmH_2O
- PEEP High: 20cmH_2O
- PEEP Low: 5 cmH_2O
- Time High: 5.0 sec
- Time Low: 5.0 sec
- Baseflow : 10
- Sensitivity: 2.0
- Enter 'Sync' at 50 %

Initiate NIV

- Monitor patient continuously
- Monitor for signs of increased distress
- Assess risk factors e.g pressure ulcers on nose

EVALUATION

Repeat ABG after 30 min of NIV

pO_2 60-70mmHg
pCO_2 40-50mmHg
pH 7.25-7.35
GCS>11
Reduced signs of distress

FiO_2 : 50%
Increase pressure support to 10cmH_2O
Monitor for risk factors
Repeat ABG after 1 hour

pO_2 >70mmHg
pCO_2 <50mmHg
pH 7.35 – 7.45
GCS>11
Continue NIV at current settings
Repeat ABG 2 hourly

pO_2 50 -60 mmHg
pCO_2 >50mmHg
pH < 7.35
GCS>11
Reduced signs of distress

Increase FiO_2 to 60%
Increase pressure support to 10cmH_2O
Monitor for risk factors
Repeat ABG after 30 min

pO_2 <50mmHg
pCO_2 >60mmHg
pH <7.20
GCS<11

Endotracheal intubation and ventilation

EVALUATION INSTRUMENT

Please indicate with an 'x' the answer that best describes your impressions of the clinical pathway for NIV according to the set criteria:

EVALUATION INSTRUMENT

	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly	X			
Simplicity		X		
Consistency	X			
Comprehensiveness	X			
Importance for nursing practice development	X			
Applicable to CCU	X			
Other (please specifiy)				

Additional comments:

_____

_____

_____

_____

_____

Thank you for your time and effort. It is much appreciated.

EVALUATION INSTRUMENT

Please indicate with an 'x' the answer that best describes your impressions of the clinical pathway for NIV according to the set criteria:

EVALUATION INSTRUMENT

	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly		✓		
Simplicity		✓		
Consistency		✓		
Comprehensiveness	✓			
Importance for nursing practice development	✓			
Applicable to CCU	✓			
Other (please specifiy)				

Additional comments:

_____

_____

_____

_____

_____

Thank you for your time and effort. It is much appreciated.

EVALUATION INSTRUMENT

Please indicate with an 'x' the answer that best describes your impressions of the clinical pathway for NIV according to the set criteria:

EVALUATION INSTRUMENT

	Exemplary	Proficient	Marginal	Unsatisfactory
Clarity – user friendly	X			
Simplicity	X			
Consistency	X			
Comprehensiveness	X			
Importance for nursing practice development	X			
Applicable to CCU	X			
Other (please specifiy)				

Additional comments:

_____

_____

_____

_____

_____

Thank you for your time and effort. It is much appreciated.

Annexure E

Clinical pathway development

E.1

Final clinical pathway

Clinical pa[illegible] ventilation

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1 Assess

Baseline data	GCS
	BP
	HR
	ABG
	SpO_2
	CXR
Baseline laboratory tests	FBC
	UKE
	PCT, CRP
History	MI

2 Plan

Clinical diagnosis of ARF	Yes	No
RR >30		
Cyanosis (peripheral and/or central)		
pO_2 >50 mmHg		
pCO_2 >50 mmHg		

3 Implement

GCS > 11 ***or*** **GCS** < 11

Consider ***endotracheal intubation*** and ***mechanical ventilation***

NIV

Mode	BiPAP	**Base flow**	10
FiO_2	0.5	**Sensitivity**	-2
PS	8 cmH_2O	**Enter "sync"**	50%
PEEP high	15 cmH_2O	**Time high and low**	6 sec
and low	5cmH_2O		

Patient preparation

⇨Explain procedure to patient
⇨Patient "awake & willing"
⇨Elevate head of bed 45°
⇨Establish patent IV access
⇨Fit mask

⇨Continuous monitoring of ***level of consciousness*** and ***vital signs***
⇨Monitor for signs of increased ***respiratory distress***
⇨Monitor for and address risk factors for ***pressure ulcers*** on nose

4 Evaluate

Repeat **ABG** after **30 minutes** following the initiation of NIV

⇨pO_2 60-70mmHg
⇨pCO_2 40-50mmHg
⇨pH 7.25-7.35
⇨GCS>11
⇨Reduced signs of distress

⇨FiO_2 : 50%
⇨Increase pressure support to 10cmH_2O
⇨Monitor for risk factors
⇨Repeat ABG after 1 hour

⇨pO_2 >70mmHg
⇨pCO_2 <50mmHg
⇨pH 7.35 – 7.45
⇨GCS>11
⇨Continue NIV at current settings
⇨Repeat ABG 2 hourly

⇨pO_2 50 - 60 mmHg
⇨pCO_2 >50mmHg
⇨pH < 7.35
⇨GCS>11
⇨Reduced signs of distress

⇨Increase FiO_2 to 60%
⇨Increase pressure support to 10cmH_2O
⇨Monitor for risk factors
⇨Repeat ABG after 30 min

⇨pO_2 <50mmHg
⇨pCO_2 >60mmHg
⇨pH <7.20
⇨GCS<11

Endotracheal intubation and mechanical ventilation

List of abbreviations	
ABG	Arterial blood gas
BiPAP	Bi-level /Bi-phasic positive airway pressure
BP	Blood pressure
CXR	Chest x-ray (portable)
FiO_2	Fractional inspired oxygen
GCS	Glasgow Coma Scale
HR	Heart rate
PEEP	Positive end-expiratory pressure
PS	Pressure support
RR	Respiration rate
sec	seconds
SpO_2	Peripheral oxygen saturation

F.1

Declaration by student

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Declaration

Student number: 23293595

I declare that **DEVELOPMENT OF A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION IN A PRIVATE HOSPITAL IN GAUTENG** 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.

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Liezl Balfour **Date**

F.2

Declaration by Editor

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2 December 2010

To whom it may concern

This is to certify that I, Alexa Kirsten Barnby, ID No. 5106090097080, a language practitioner registered with SATI, have edited Liezl Balfour's masters dissertation entitled DEVELOPING A CLINICAL PATHWAY FOR NONINVASIVE VENTILATION. The onus is, however, on the student to effect the corrections and changes suggested.

Signed: