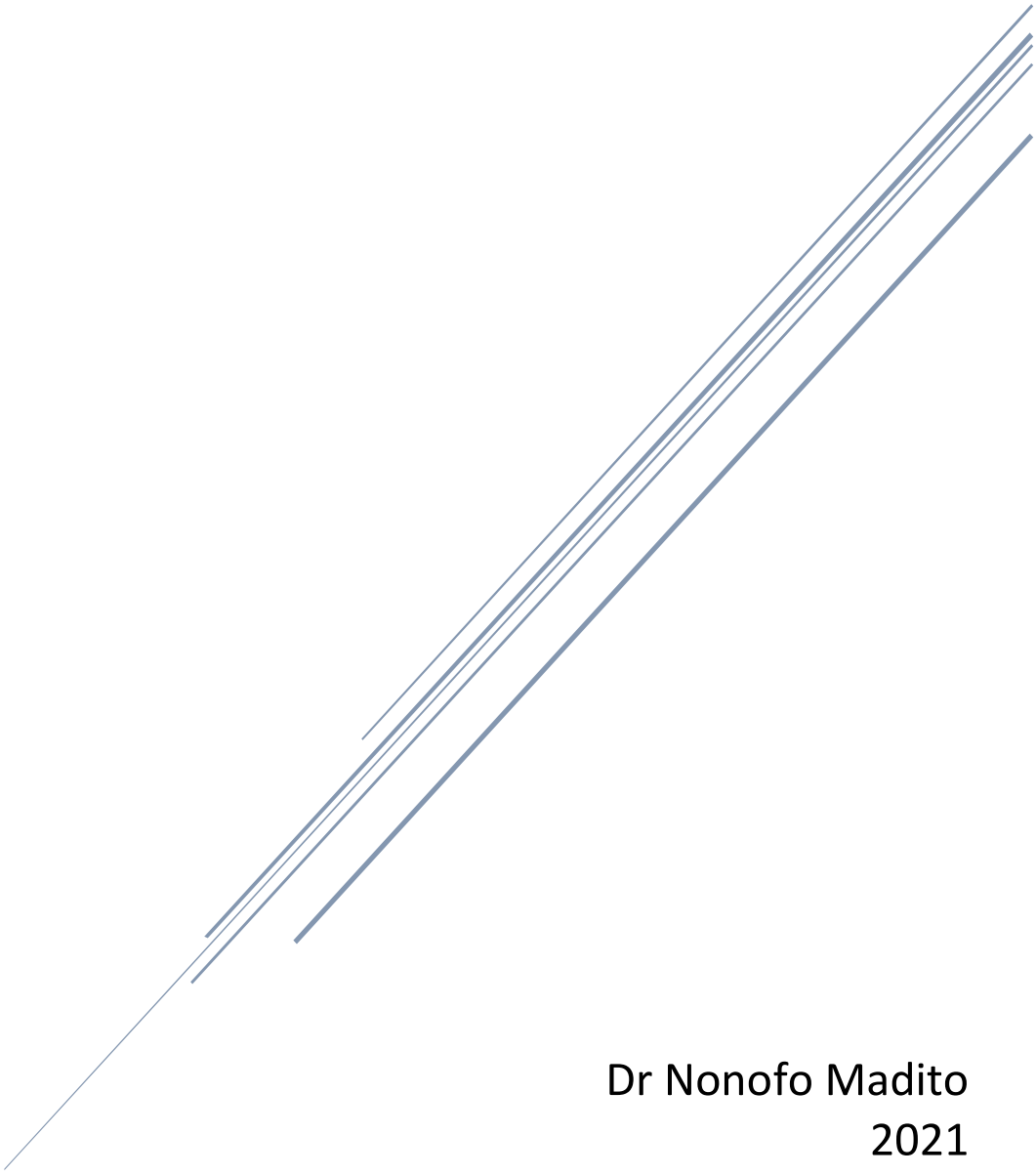
A clinical audit of Red Blood Cell transfusion at National District Hospital



Dr Nonofo Madito

2021

A clinical audit of Red Blood Cell transfusion at National District Hospital

by

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Student number: 2018730636

Submitted in partial fulfilment of the requirements for the degree

Master of Medicine in Family Medicine

at the

Department of Family Medicine

School of Clinical Medicine

Faculty of Health Sciences

University of the Free State

Supervisor: Prof DT Hagemeister

Biostatistician: Mr FC van Rooyen

2021

DECLARATION

I, Dr Nonofo Snowy Madito, declare that the coursework master's degree mini-dissertation that I herewith submit in a publishable manuscript format for the Master's Degree qualification MMed (Family Medicine) at the University of the Free State is my independent work, and that I have not previously submitted it for a qualification at another institution of higher education.

Signature: 

Date: 25/10/2021

DEDICATIONS

I would like to dedicate this dissertation to God, my husband, Mr G Mangoye, my sisters, Ms TS Madito and Mrs MD Motingwe, my parents Mr BP and Mrs JK Madito and my mentors, Drs A and Z Akin, for their love, patience, sacrifices and continued support.

ACKNOWLEDGEMENTS

I would like to convey my sincere gratitude to my colleagues for their support:

- Prof DT Hagemeister, Department of Family Medicine, my study leader, for his support and guidance.
- Mr FC van Rooyen, Department of Biostatistics, for assisting with data analysis.
- Prof WJ Steinberg, Department of Family Medicine, the postgraduate programme coordinator, for his motivation and leadership.
- Mr J Botes, Department of Family Medicine, for assisting with the technical aspects of the research.
- All consultants and registrars at the Department of Family Medicine.
- The Health Sciences Research Ethics Committee (HSREC) for approving the protocol.
- The Free State Department of Health for permitting the use of clinical records.
- The staff and management of National District Hospital.

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ABSTRACT

Background:

Red blood cell transfusion is one of the most critical and expensive live-saving treatment modalities. Literature has shown that restrictive transfusion is safe and yields good patient outcomes. Evidence shows that a clinical audit is one of the most valuable instruments to determine if transfusion practices align with the guidelines and identify knowledge deficiencies. The National District Hospital was audited against the South African guidelines, including trigger conditions, administrative standards and monitoring requirements.

Aim:

To evaluate the red blood transfusion practice and patients' outcomes at National District Hospital and determine adherence to transfusion guidelines.

Methods:

A retrospective descriptive study was conducted. Blood transfusion registers in the hospital were used to compile all transfusion episodes from 01 June 2019 to 31 December 2019. Files were retrieved from the admissions office using that list. A datasheet was used. The department of Biostatistics at the University of the Free State processed the data.

Results:

One hundred eighteen (118) transfusion episodes occurred in the study period, 78 files could be retrieved, but only 76 met the inclusion criteria. The median age was 47. HIV (44.7%) was the most common comorbid condition. A large percentage of patients (81.6%) received oral iron as an additional treatment. Pre-transfusion haemoglobin was documented for all patients with a median of 4.6 g/dL. All ordered units were transfused. The audit revealed that 68% of the cases adhered to the guidelines.

Conclusion:

Most of the transfusion episodes adhered to the guidelines. Training on transfusion medicine recommended.

CHAPTER 1: INTRODUCTION

1.1 Background

Red blood cell transfusion is one of the most critical and expensive live-saving treatments and as such, has to be used correctly, balancing risks and benefits and considering patient outcomes (1,2). Evidence suggests that red blood cell transfusion predisposes patients to multiorgan dysfunction and acute respiratory distress syndrome (2).

The best medical practice would be to transfuse enough red blood cells to improve the patient's clinical picture while avoiding unnecessary transfusions; studies from revealed that more than one -third of red blood cell transfusions were not indicated (3).

Besides the laboratory values, there are many other factors to consider before transfusing a patient , such as clinical condition, age, comorbid conditions, baseline function, and the ability to compensate for the blood loss (4).

Literature has shown that restrictive transfusion was safe and yielded good patient outcomes even in older patients (3,4). The aim of transfusing red blood cells to anaemic or bleeding patients is to restore oxygen-carrying capacity, improve tissue oxygenation (1), and expanding circulating volume, especially in bleeding patients (4,5). However, in critically ill patients, red blood cell transfusion does not restore oxygen-carrying capacity and is instead associated with poorer patient outcomes (2).

Practitioners should perform proper and thorough investigations on all anaemic patients to identify and manage underlying causes instead of simply transfusing the patient and leaving the cause unknown (1). Frail patients should only receive transfusions if they have severe symptoms, and if other treatment modalities have not been effective (1).

Patients booked for elective surgical procedures need to be managed and investigated adequately as well as having their haemoglobin optimised before the surgical procedure, and those who undergo emergency procedures with haemoglobin values of < 8 g/dL need to be transfused (1). Pre-operative anaemia is a contra-indication to elective surgery. Obstetric haemorrhage is a life-threatening emergency; thus, there is the need to transfuse the patient when the haemoglobin is < 6, and the patient is symptomatic (1).

In transfusion medicine, there is a paradigm shift towards what is called patient blood management (1,5,6). This evidence-based practice focuses on improving patient outcomes by preserving the patient's blood (5). This strategy is not rejecting transfusions, it restricts it to where prevention of blood loss and support for the body's red blood generation are not sufficient. It will cut costs and improve patient outcomes if implemented correctly (5,6).

An estimated 85 million units of red blood cells are transfused across the globe every year (9). However, The introduction of patient blood management practices led to decreased transfusion episodes resulting in cost savings and improved patient outcomes (5,9). Transfusion of red blood cells is associated with several risks, including transfusion reactions (1). Patient safety is of paramount importance, and in order to minimize these risks there are checklists and other procedures that practitioners should follow before and during transfusion (1,2,4,7).

Audits done illustrated best practices such as identification of the patient, transfusion checklists and verification of the unit before transfusion (8). Interventions to ensure that the blood is transfused within 30 minutes of receipt and running it over four hours improves patient outcomes (7,8). However, knowledge gaps regarding transfusion practices remained (8–10).

South Africa is a middle-income country with a resource-limited public sector. A high prevalence of anaemia amongst the adult population was recorded in 2018 (5). Women of childbearing age and the elderly were severely affected. Common types of anaemia identified

were iron deficiency, HIV-related anaemia and anaemia of chronic disease. A significant number of admitted anaemic patients had unfavourable outcomes and it is crucial to identify underlying causes and manage them well (1,5).

The country's high prevalence of HIV also reduces the number of potential blood donors and increases morbidity (5,10). Therefore, anaemia should be managed appropriately to decrease blood transfusion demand and improve the population's general health and productivity (5).

The academic hospitals affiliated with the University of the Witwatersrand conducted a study on the knowledge about usage of blood and blood products amongst doctors of all levels (10). The study revealed that their experience was generally deficient, even though consultants did better than their juniors as expected, which is comparable to other low-to-middle-income countries.

A similar study in Uganda assessed Oncologists' Knowledge and Practices regarding blood transfusion (11). Most doctors admitted having knowledge gaps and needing more training in transfusion medicine, their decision to transfuse was based on peer influence and often led to inappropriate transfusions. The absence of transfusion guidelines in their institution contributed to inappropriate transfusions.

There were several other clinical audits done on red blood cell transfusion; including one at Kimberly Hospital Complex, South Africa (9). The study on chronically anaemic adult patients assessed if practitioners transfused according to guidelines, mainly triggered by haemoglobin level < 6.9 g/dL and symptoms of anaemia. The hospital adhered to transfusion guidelines and most of the transfusions were appropriate.

Palliative care practices in the United Kingdom conducted a national audit of red blood cell transfusion practice (12). The study evaluated the transfusion practices of several palliative centres and evaluated their alignment to guidelines. Anaemia of chronic disease was highly prevalent at 38%. Unfortunately, most patients who received red blood cell transfusions did

not have further investigations done such as iron studies, folate, Vitamin B12, ferritin and transferrin saturation, hence alternate treatment was not given when indicated (12,13).

An inappropriately low number of patients received Tranexamic acid even though they were actively bleeding or had recent blood loss, despite significant evidence that it reduces blood loss (1,12). Low haemoglobin was a common indication for transfusion in the majority of patients as well as shortness of breath, while fatigue was amongst the highly ranked signs (12,13).

Most patients received two or more units without re-evaluations between transfusions, only 18% of patients had significant clinical improvement, and 32% of the patients died within 30 days (12).The study showed that red blood cell transfusion is not beneficial in patients with advanced disease and that doctors should do proper anaemia workup and restrict transfusions in chronically critically ill patients (12,13).

The American College of Pathologists audited red blood cell transfusions in 128 Hospitals to assess if the hospitals were compliant with the guidelines (14) with the focus being on haemoglobin as transfusion trigger. A median haemoglobin threshold of 8.0-8.9 g/dL for patients of all categories was used, except for those with cardiovascular and respiratory disease, for whom a limit of 9.0-9.9 g/dL was used. Sixty-nine percent of the hospitals were found to be compliant.

The motivating factor for compliance could be that 35% of the audited institutions required compliance with guidelines for physicians to enjoy certain privileges (14). More countries are moving towards evidence-based practice such as transfusing at lower haemoglobin levels and increasing single unit transfusion, as indicated in a study done in Finland (15).

Clinical audits and studies done in Obstetrics and Gynaecology also indicate that patients are transfused inappropriately (16,17). A study in Bangladesh assessed the rate of unnecessary transfusions in admitted Obstetrics and Gynaecology patients to be 9.23%, comparable to

other studies in the world (17). Sixty-four of the patients had preoperative anaemia, and 24% had antenatal anaemia, which are both treatable causes, 46% of Gynaecology cases received transfusions secondary to miscarriages. Interventions were sometimes delayed or inadequate.

The postpartum period may pose significant risks for severe blood loss, a Dutch study found that 46% of transfusions were inappropriate partly due to over transfusion as their guidelines stated the transfusion trigger haemoglobin, but they did not indicate the target haemoglobin value (14).

Evidence shows that a clinical audit is one of the most valuable instruments to determine if transfusion practices align with the guidelines and identify knowledge deficiencies (8,10,18). This study at National District Hospital helped describe their current transfusion practices. Strengths and weaknesses were identified and addressed in addition means to improve current transfusion practices were devised.

1.1.1 South African transfusion guidelines

Table 1 below highlights the South African guidelines, including the trigger conditions, administrative standards and monitoring requirements (1). Transfusion triggers describes the different haemoglobin levels at which patients can be transfused based on their individual clinical status. Patients undergoing surgical procedures or who are critically ill should be transfused at haemoglobin level of 7 g/dL or less. Those with pre-existing cardiovascular disease or with acute blood loss of more than thirty percent of the adult blood volume should be transfused at a higher haemoglobin of 8 g/dL or less.

Administrative standards involve patient identification and verification. The guidelines stipulate that every patient who receives blood transfusion must have a valid consent form in their file. Two signatures of personnel who conducted the verifications must also appear on the form.

All patients must be monitored during the entire procedure as indicated in the guidelines. Parameters that must be recorded include vital signs and transfusion reactions. Baseline vital signs must be documented, then every fifteen minutes for the first half hour. Transfusion reactions must be reported to the relevant clinicians as well as the Blood Bank. Each unit of blood should be transfused within six hours.

Table 1: South African transfusion guidelines

Transfusion triggers
a) Haemoglobin < 6 g/dL b) Haemoglobin < 7 g/dL in intraoperative, post-operative and critically ill patients. c) Haemoglobin < 8 g/dL in pre-operative patients with pre-existing cardiovascular disease or increased risk of blood loss > 500ml. d) Acute blood loss of > 30% of the blood volume in an adult.
Patient identification and verification
a) Two signatures of personnel who conducted the verifications to appear on the form. b) A valid consent form should be in the patient's file. c) The practitioners should not transfuse the unit if there are any discrepancies.
Monitoring of the patient
a) The patient's baseline vital signs to be recorded before commencing the transfusion. b) Record vital signs throughout the procedure, every 15 minutes for the first half hour, then every 30 minutes. c) Transfuse within six hours. d) Report all transfusion reactions accordingly.

1.2 Problem statement

National District Hospital is a level one hospital in Bloemfontein. It is situated 3.9km from Universitas Academic Hospital, a central hospital providing the most highly specialized level of care in the Free State province. The blood bank servicing National District Hospital is at Universitas Academic Hospital.

There is one unit of red blood cell available on-site for emergency transfusion purposes at any given time. During the three months from 1 October 2019 to 31 December 2019, 79 patients were transfused costing the hospital R171,187.96 according to data provided by the Chief Executive Officer of National District Hospital.

The absence of a blood bank on the hospital premises and the limited emergency blood supply was motivation to investigate whether our patients are assessed appropriately, and whether alternative treatments are used as recommended. The high cost of red blood cell transfusion as well the associated potential risks were additional motivation for this study. Therefore, improving healthcare practitioner's knowledge of transfusion medicine is expected to lead to better practice.

The study should then answer the question: Are red blood cell transfusions at National District Hospital done appropriately?

1.3 Aims and Objectives

1.3.1 Aims

The study's aim was to evaluate the Red Blood Cell transfusion practice and patients' outcomes at National District Hospital, and to determine adherence to transfusion guidelines.

1.3.2 Objectives

The study's objectives were:

- To describe the current practice of blood transfusion.
- To evaluate post transfusion outcomes of patients at National District Hospital.
- To determine current transfusion triggers and co-relate them with the National Transfusion Guidelines.
- To assess whether the National Transfusion Guidelines were adhered to.

1.4 Methodology

1.4.1 Study design

A retrospective descriptive study was done.

1.4.2 Study population and sample

Study population for this research included all patients who received blood transfusion at National District Hospital. The sample consisted of all patients who received red blood cell transfusion at National District Hospital between 1 June 2019 and 31 December 2019. The estimated sample size was 100. A total of 118 transfusion episodes occurred during the period, and 76 met the inclusion criteria and were audited.

Inclusion criteria: All patients who received a transfusion for any clinical condition during the study period at National District Hospital.

Exclusion criteria: Patient's with missing files or incomplete information were excluded from the study.

1.4.3 Measurement

The researcher compiled a list of all patients who received red blood cell transfusion using the Blood transfusion registers in the wards of the hospital. The pre-transfusion haemoglobin on the request form was correlated with the one on file or laboratory records. The researcher retrieved patients' files from the admission department.

The researcher collected all the data without a research assistant.

A hard-copy based data sheet was used to extract relevant information from the patients' files, which was then transferred on to a Microsoft Excel spreadsheet. The datasheet was developed using information from the literature review and the South African National Blood Service Clinical Guidelines for the use of Blood Products in South Africa. No identifiable patient details were captured on the data sheet, as it only contains study numbers.

A master file with the names of the patients and their study number was kept strictly separate and was only used to identify relevant files during the data collection.

The data sheet has five sections:
Section A gathered information regarding the patient's demographics and clinical background such as age, gender, admission diagnosis and comorbid conditions.

Section B covered more specific information regarding transfusion triggers. The researcher checked if the patient had pre-existing anaemia, symptomatic anaemia, if anaemia workup was done such as Iron studies, Folate, Ferritin, Vitamin B12, transferrin saturation and full blood count and whether alternative treatment had been given where indicated.

Section C dealt with patient identification and verification, i.e. the consent form and verification signatures from 2 practitioners.

Section D measured patient monitoring. This included pre-transfusion haemoglobin, number of units ordered, number of units transfused, number of units returned to blood bank. The transfusion duration as well as vital signs before, during and post transfusion were assessed.

Section E measured patients' outcomes. It assessed if the patient was discharged, re-admitted, referred, died and if the National Guidelines were adhered to.

The researcher concluded on the appropriateness of the transfusion based on adherence to the South African Transfusion Guidelines.

1.4.4 Pilot study

A pilot study was done after the approval by the Health Science Research Ethics Committee and the Free State Department of Health to assess the practicalities of data collection and tools. Ten data forms were completed from patients that were transfused in June 2019, and the data was included in the main study as no changes were made to the datasheet.

1.4.5 Data analysis and interpretation

The analysis was done with the assistance of the department of biostatistics at the University of Free State. An electronic datasheet was created using Microsoft Excel. Continuous variables were summarised by means, standard deviations or medians and percentiles. Categorical variables were summarised by frequencies and percentages.

1.4.6 Data management

Patient confidentiality was maintained. Each patient was given a study number. There were no patient identifiers used on the data collection sheet. The information was collected from the patient's file at the hospital and transcribed to a datasheet. The datasheets and the master file were kept in a safe place. The patients' files were not removed from the hospital and were

kept in a locked office during data collection. The data in Excel was protected by means of a computer password.

1.4.7 Implementation of findings

The results will be made available to the management of National District Hospital, as well as appropriate recommendations. report will be submitted to the University of the Free State as part of the criteria for the Masters in Family Medicine degree.

1.4.8 Ethical Aspects

The Health Sciences Research Ethics Committee of the University of the Free State (UFS-HSD2020/1109/2508) approved the research. The head of the Free State Department of Health gave permission for the study. Only the researcher handled the datasheets to maintain confidentiality. No patient identifiers were used.

1.5 Layout of this manuscript

- Chapter 1:
  - Introduction
  - Aims and objectives
  - Methodology
  - Layout of the manuscript

- Chapter 2:
  - Introduction to chapter
  - Journal information
  - Publishable article: A clinical audit of red blood cell transfusion at National District Hospital

- Annexures
  - Appendix A: HSREC Approval
  - Appendix B: Free State Department of Health Approval
  - Appendix C: Data Sheet
  - Appendix D: Protocol
  - Appendix E: South African Family Practice Journal
  - Appendix F: TurnItIn Report

1.6 Summary of Chapter 1

The thought process was discussed extensively in the literature review. Local and international protocols and guidelines regarding transfusion of red blood cells were outlined. A method was devised to assess the transfusion practices at National District Hospital. In the next chapter, the results will be discussed in the form of a publishable manuscript.

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CHAPTER 2: THE PUBLISHABLE MANUSCRIPT

2.1 Introduction to chapter

Chapter two of the thesis contains the manuscript which is written according to the South African Family Practice Journal. Author guidelines are also attached. References for the articles used are included.

2.2 Journal information

The South African Family Practice journal is supposed by the South African Academy of Family Practitioners. The journal is accredited by the DHET, it appears on both the DHET and Scopus lists.

Journal:	South African Family Practice (SAFP)
Abbreviation:	S Afr Fam Pract
URL:	https://safpj.co.za/index.php/safpj/pages/
ISSN:	2078-6190 (PRINT) /2078-6204 (ONLINE)
Format:	Open Access, published online and printed format
Publishers:	African Online Scientific Information Systems (Pty) Ltd t/a AOSIS

2.3 Article in a publishable format

An article in publishable format was prepared according to the guidelines of the South African Family Practice journal (Appendix E)

Type of contribution: Original research

Title: A clinical audit of red blood cell transfusion at National District Hospital

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ABSTRACT

Background:

Red blood cell transfusion is one of the most critical and expensive live-saving treatment modalities. Literature has shown that restrictive transfusion is safe and yields good patient outcomes. Evidence shows that a clinical audit is one of the most valuable instruments to determine if transfusion practices align with the guidelines and identify knowledge deficiencies. The National District Hospital was audited against the South African guidelines, including trigger conditions, administrative standards and monitoring requirements.

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Conclusion:

Most of the transfusion episodes adhered to the guidelines.

Keywords: Red blood cells; transfusion; haemoglobin; guidelines; audit; anaemia

INTRODUCTION

Social value of the study

South Africa is a middle-income country with a resource-limited public health sector. Red blood cell transfusion is one of the most critical and expensive live-saving treatment modalities (1,2). It thus has to be used correctly, bearing in mind the risks vs benefits and patient outcomes (1,2).

An estimated 85 million units of red blood cells are transfused across the globe every year (3). However, the introduction of Patient Blood Management practices led to decreased transfusion episodes resulting in cost savings and improved patient outcomes (3,4).

A high prevalence of anaemia amongst the adult population of South Africa was recorded in 2018 (4). Women of childbearing age and the elderly were severely affected. Common types of anaemia identified were iron deficiency, HIV-related anaemia and anaemia of chronic disease. A significant number of admitted anaemic patients had unfavourable outcomes and it is crucial to identify underlying causes and manage them well (1,4).

The country's high prevalence of HIV also reduces the number of potential blood donors and increases morbidity (4,5). Therefore, anaemia should be managed appropriately to decrease blood transfusion demand and improve the population's general health and productivity (4).

A study conducted at the University of the Witwatersrand on the knowledge of blood and blood products usage amongst doctors of all levels (5) revealed that their experience was generally deficient, even though consultants did better than their juniors as expected, which is comparable to other low-to-middle-income countries.

In a similar study among oncologists in Uganda (6) most doctors admitted to having knowledge gaps and needing more training in transfusion medicine. Their decision to transfuse was

reportedly often based on peer influence, leading to inappropriate transfusions, to which the absence of transfusion guidelines further contributed.

Several other clinical audits were done on red blood cell transfusion, including one at Kimberly Hospital Complex, South Africa (3). The study on chronically anaemic adult patients assessed if practitioners transfused according to guidelines, mainly triggered by haemoglobin level < 6.9 g/dL and symptoms of anaemia. The hospital adhered to transfusion guidelines, and most of the transfusions were appropriate.

Scientific value

Restrictive transfusion has been shown to be safe, yielding good outcomes even in older patients (7,8). Transfusing red blood cells to anaemic or bleeding patients aims to restore oxygen-carrying capacity, improving tissue oxygenation (1). It also expands circulating volume, especially in bleeding patients (4,8). Red blood cell transfusion however does not restore oxygen-carrying capacity in critically ill patients and is associated with poorer patient outcomes (2).

Practitioners should perform proper and thorough investigations on all anaemic patients to identify and manage underlying causes instead of simply transfusing the patient and leaving the cause unknown (1). Frail patients should only receive transfusions if they have severe symptoms, and if other treatment modalities have not been effective (1).

Patients booked for elective surgical procedures need to be managed and investigated adequately as well as having their haemoglobin optimised before the surgical procedure, and those who undergo emergency procedures with haemoglobin values of < 8 g/dL need to be transfused (1). Pre-operative anaemia is a contra-indication to elective surgery. Obstetric haemorrhage is a life-threatening emergency; thus, there is the need to transfuse the patient when the haemoglobin is < 6, and the patient is symptomatic (1).

Transfusion of red blood cells is associated with several risks, including transfusion reactions (1). Patient safety is of paramount importance, and in order to minimize these risks there are checklists and other procedures that practitioners should follow before and during transfusion (1,2,8,9).

Audits done illustrated best practices such as identification of the patient, transfusion checklists and verification of the unit before transfusion (10). Interventions to ensure that the blood is transfused within 30 minutes of receipt and running it over four hours improves patient outcomes (9,10). However, gaps in knowledge with regards to transfusion practices remained (3,5,10).

The American College of Pathologists audited red blood cell transfusions in 128 Hospitals to assess if the hospitals were compliant with the guidelines (11) with the focus being on haemoglobin as transfusion trigger. A median haemoglobin threshold of 8.0-8.9 g/dL for patients of all categories was used, except for those with cardiovascular and respiratory disease, for whom a limit of 9.0-9.9 g/dL was used. Sixty-nine percent of the Hospitals were found to be compliant.

The motivating factor for compliance could be that 35% of the audited institutions required compliance with guidelines for physicians to enjoy certain privileges (11). More countries are moving towards evidence-based practice such as transfusing at lower haemoglobin levels and increasing single unit transfusion, as indicated in a study done in Finland (12).

Clinical audits and studies done in Obstetrics and Gynaecology also indicate that patients are transfused inappropriately (13,14). A study in Bangladesh assessed the rate of unnecessary transfusions in admitted Obstetrics and Gynaecology patients to be 9.23%, comparable to other studies in the world (14). Sixty-four of the patients had preoperative anaemia, and 24% had antenatal anaemia, which are both treatable causes, 46% of Gynaecology cases received transfusions secondary to miscarriages. Interventions were sometimes delayed or inadequate.

Evidence shows that a clinical audit is one of the most valuable instruments to determine if transfusion practices align with the guidelines and identify knowledge deficiencies (5,10,15). This study at National District Hospital will help describe the current transfusion practices. Strengths and weaknesses will be identified and addressed in addition to devising means to improve the practice.

Problem statement

National District Hospital is a level one hospital in Bloemfontein. It is situated 3.9km from Universitas Academic Hospital, a central hospital providing the most highly specialized level of care in the Free State province. The blood bank servicing National District Hospital is at Universitas Academic Hospital.

There is one unit of red blood cells available on-site for emergency transfusion purposes at any given time. During the three months from 1 October 2019 to 31 December 2019, 79 patients were transfused costing the hospital R171,187.96 according to data provided by the Chief Executive Officer of National District Hospital.

The absence of a blood bank on the hospital premises and the limited emergency blood supply was motivation to investigate whether our patients are assessed appropriately, and whether alternative treatments are used as recommended. The high cost of red blood cell transfusion as well the associated potential risks were additional motivation for this study. Therefore, improving healthcare practitioner's knowledge of transfusion medicine is expected to lead to better practice.

The study should then answer the question: Are red blood cell transfusions at National District Hospital done appropriately?

Aims

The study's aim was to evaluate the red blood cell transfusion practice and patients' outcomes at National District Hospital, and to determine adherence to transfusion guidelines.

Objectives

The study's objectives were:

- To describe the current practice of blood transfusion.
- To evaluate post-transfusion outcomes of patients at National District Hospital.
- To determine current transfusion triggers and co-relate them with the National Transfusion Guidelines.
- To assess whether the National Transfusion Guidelines were adhered to.

Research methods and design

Study design

A retrospective descriptive study was done.

Study setting

National District Hospital is a level one Hospital in Bloemfontein. It is situated 3.9km away from Universitas Academic Hospital, a central hospital providing the highest level of care in the Free State province. The blood bank servicing National District Hospital is at Universitas Academic Hospital. There is one unit of red blood cell available on-site for emergency transfusion purposes at any given time.

Study population and sample

The study population for this research was all patients who received blood transfusion at National District Hospital between 1 June 2019 and 31 December 2019. A total of 118 transfusion episodes occurred during the period, and 76 were audited.

Inclusion criteria: All patients who received a transfusion for any clinical condition during the study period at National District Hospital.

Exclusion criteria: Patient's with missing files and incomplete information were excluded from the study.

Data collection

The researcher collected data alone without the use of a research assistant. Blood transfusion registers in the hospital were used to compile all transfusion episodes from 01 June 2019 to 31 December 2019. Subsequently, files were retrieved from the admissions office using that list. A datasheet was used. Each patient was allocated a study number which was then used on the datasheet. No patient identifiers were used on the form. The handwritten form was captured on an excel spreadsheet and submitted to biostatistics for analysis. The researcher concluded on the appropriateness of the transfusion based on adherence to the South African Transfusion Guidelines.

Pilot study

Ten files of patients who received blood transfusion in June 2019 were selected, and as no changes were made on the datasheet they were included in the study sample.

Data analysis

The Department of Biostatistics, Free State University, assisted with the analysis of data. The information from the datasheet was captured on Microsoft Excel. Continuous variables were summarised by means, standard deviations, medians and percentiles. Frequencies and percentages summarised categorical variables.

Ethical considerations

The Health Sciences Research Ethics Committee of the University of the Free State (UFS-HSD2020/1109/2508) approved the research. The head of the Free State Department of Health gave permission for the study. Only the researcher handled the datasheets to maintain confidentiality. No patient identifiers were used.

Results

Patient demographics

One hundred eighteen (118) transfusion episodes occurred between 01 June 2019 and 31 December 2019, 78 files were retrieved, but only 76 met the inclusion criteria and formed part of the study.

Females comprised 75% (n=57) and males 25% (n=19) of the sample. The median age was 47 years (range 13-89 years, interquartile range 33-66 years).

Table 1: Clinical characteristics of the patients.

Admission diagnosis n (%)		Co-morbid conditions n (%)	
Gastrointestinal bleed	3 (4.0)	Hypertension	25 (32.9)
Abnormal uterine bleed	9 (11.8)	Diabetes	8 (10.5)
Renal failure	13 (17.1)	HIV	34 (44.7)
Pneumonia	14 (18.4)	Malignancy	4 (5.3)
Anaemia	18 (23.7)	PTB	3 (3.9)
Severe epistaxis	5 (6.6)	Chronic kidney disease	3 (3.9)
Malignancy	3 (3.9)		
Cardiac failure	2 (2.6)		
Abortion	4 (5.3)		
Caesarian section	2 (2.6)		
Haemorrhoids	3 (3.9)		

Table 1 summarises the patients' clinical characteristics, including the admission diagnosis and comorbidities. Anaemia was the most common admission diagnosis (23.7%), followed by Pneumonia (18.4%). Renal failure (17.1%) was also high on the list.

Some patients presented with a history of blood loss due to gastrointestinal bleed, abnormal uterine bleed, severe epistaxis, malignancy and abortion on admission. Other underlying chronic medical conditions were also identified. There was a high prevalence of HIV (44.7%) under comorbid conditions.

Table 2 highlights the various investigations done and additional treatment given. Oral iron therapy was the most prescribed treatment at 81.2%. Folate was also used a lot as 76.3% of patients received it. No patient received erythropoietin in this study, whilst a small percentage received tranexamic and vitamin B12.

Table 2: Anaemia workup and additional treatment

Anaemia workup	n (%)	Additional treatment	n (%)
Iron studies	51 (67.1%)	Oral iron	62 (81.6%)
Folate	45 (59.2%)	Folate	58 (76.3%)
Vitamin B12	44 (57.9%)	Vitamin B12	2 (2.6%)
Reticulocyte production index	26 (34.2%)	Tranexamic Acid	12 (15.8%)
Other(Haptoglobin)	10 (13.2%)	Erythropoietin	0

Out of 76, 19 patients in the study had pre-existing anaemia. Fifty-seven (75.0%) of the patients had no previous history of anaemia. Iron deficiency anaemia was the most common type identified 15 (19.7%). Only one patient each (1.3%) presented with Vitamin B12

deficiency and myelofibrosis respectively. Two patients (2.6%) had anaemia of chronic disease.

Figure1 illustrates the frequency of the different types of anaemia found amongst the patients.

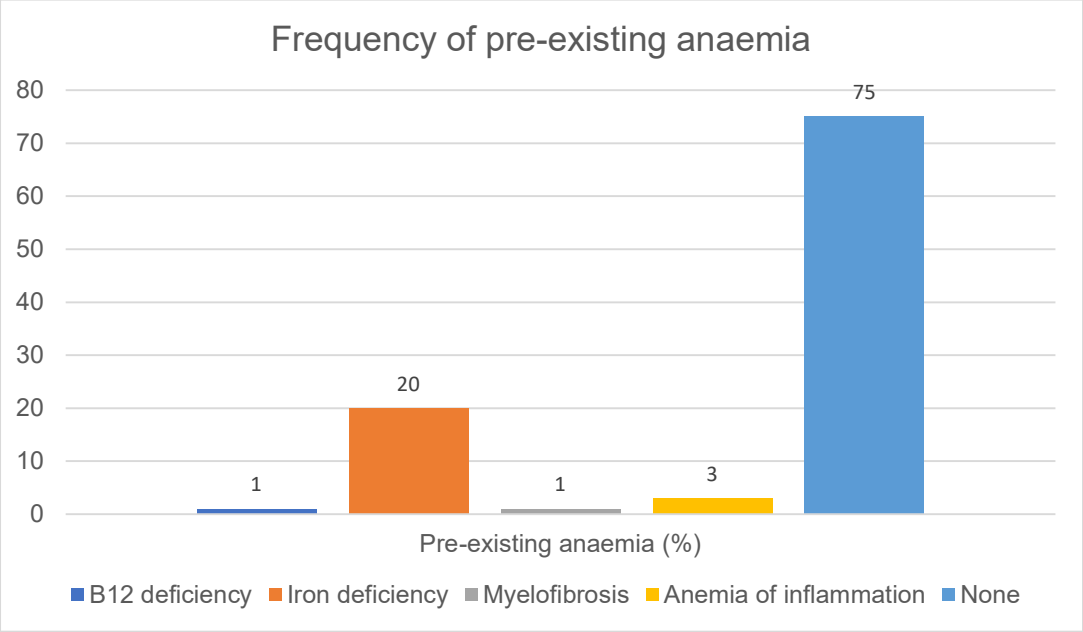

Figure 1: Pre-existing anaemia (in percentage) (n=76)

Table 3: Highlights transfusion indications

Indications	n=76
Symptomatic anaemia	75 (98.7%)
Pre-operative patient	1 (1.3%)

Pre-transfusion haemoglobin is one of the transfusion triggers, and it was documented for 76 patients. The median was 4.6 g/dL (inter-quartile range 3.95-5.5 g/dL). Post-transfusion haemoglobin was recorded for 55 patients, and the median was 6.9 g/dL (inter-quartile range

5.4-7.9 g/dL). The p Value is <0.0001 which indicates that there is a statistically significant difference between the pre- and post-transfusion haemoglobin. All files audited contained signed consent and had two verification signatures.

Monitoring

A single unit of red blood cells had been ordered in 52.6% of the patients. Two units were ordered in 46.1% of the cases and three units in only 1.3% of the patients. All units ordered were transfused, and none returned to the blood bank. The median transfusion time was 6.5 hours (interquartile range 4.0–9.0 hours).

Baseline vital signs were recorded in 100% of the patients. Regular vital signs were recorded during the transfusion in 98.7% of the patients. Only 93.4% of the cases had post-transfusion vital signs.

Patient Outcomes

Only one patient developed a documented transfusion reaction (Chest pain). A total of 72 out of 76 patients were discharged home and 71 of them had referral letters for follow up visits either at the hospital or local clinic. No death was recorded in the study. Four patients were transferred out to other facilities.

Figure 2 summarises the outcomes of the thirty-day follow-up. Many of the patients (75%) did not have data recorded. More than 6% were re-admitted, and 18% were healthy.

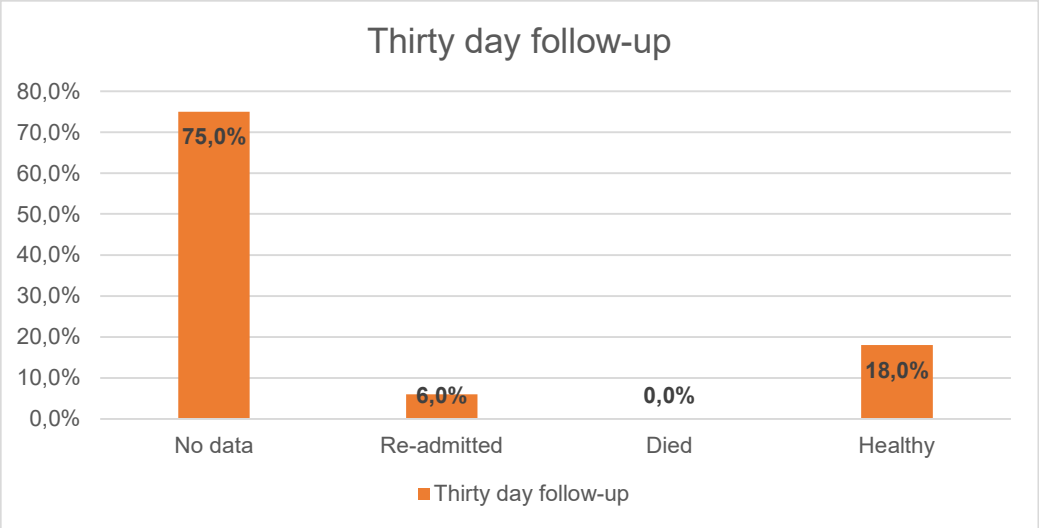

Figure 2: Thirty-day follow-up (in percentage) (n=76)

Figure 3 illustrates the frequency of adherence to National guidelines. Adherence was evaluated based on the pre-transfusion haemoglobin, comorbid conditions, investigations for anaemia workup, additional treatment, presence of valid consent, two verification signatures, transfusion time of fewer than six hours, documentation of post-transfusion haemoglobin, documentation of baseline vital signs, transfusion and post-transfusion vital signs as well as a record of transfusion reactions. The audit revealed that 68% of the cases adhered to the guidelines, and 32% did not.

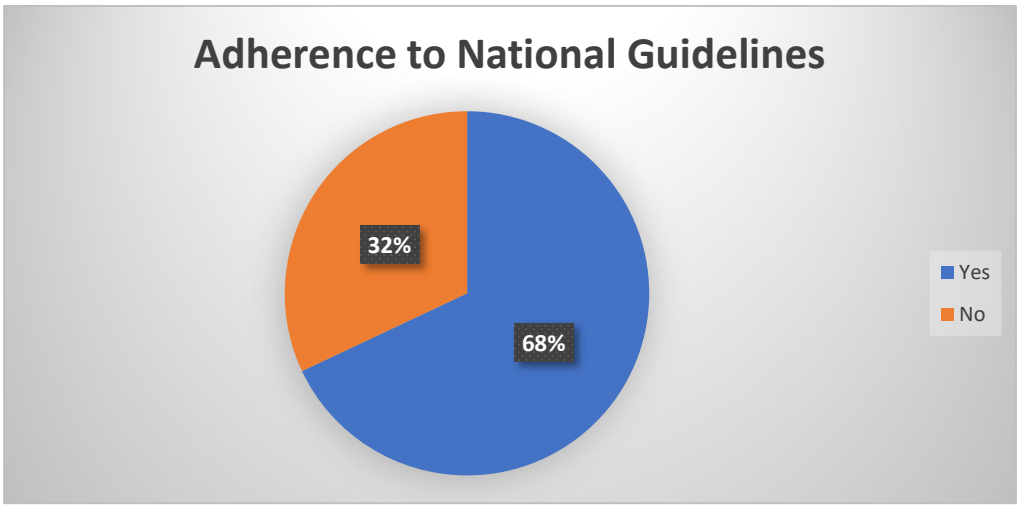

Figure 3: Frequency (in percentage) of adherence to National guidelines (n=76)

Discussion

Demographics

Blood transfusion is one of the most expensive life-saving treatments in our daily practice. However, there is an increasing trend to move towards a more restrictive approach (2,8,11).

The study evaluated the red blood cell transfusion practice and patient outcomes at National District Hospital and determined adherence to transfusion guidelines. Patients of different age groups and gender categories received blood transfusion as was described in this study. The median age was 47 years (range 13- 89 years), aligned with similar studies with a mean age of 47.3 years(7). Females (75%) constitutes a higher number compared to males (25%), and other studies followed the same trend (7).

Clinical characteristics

Anaemia (23.7%) was the most common admission diagnosis. However, it is a symptom, and the underlying cause needs to be investigated and an appropriate diagnosis made (1).

Pneumonia was the second-highest admission diagnosis amongst the patients who received transfusion at (18.4%). Furthermore, evidence shows that red blood cell transfusion predisposes to acute respiratory distress syndrome (2,8). Moreover, the risk of morbidity and mortality is higher in critically ill patients (16). Therefore, every patient should be individualised and risks -benefit ratio considered before deciding to transfuse.

Patients with ongoing blood losses need to be transfused as part of resuscitation, such as acute gastrointestinal bleed (4.0%) or severe epistaxis (6.6%).

In this study, almost half of the patients (44.7%) were HIV positive, which compares well to a study done in Kimberly (3). A high number of HIV positive patients in this study is consistent with the high prevalence rate of HIV in South Africa (5). HIV predisposes patients to cytopenias and anaemia of chronic disease. (1,3,4,6). Subsequently, many of them will present to the

hospital with symptomatic anaemia. It appears that those patients get transfused despite associated risks and the option of alternative treatment being available. In the same way, HIV positive patients should also have anaemia workup done as they can have other causes of anaemia other than cytopenias.

Hypertension (32.9%) was another common comorbid condition in this study. Hypertension can lead to complications such as renal impairment, congestive cardiac failure, end-diastolic dysfunction, amongst others which are all risk factors for transfusion-associated circulatory overload (9). Secondly, Hypertension is one of the transfusion-related adverse reactions (1). Hence, there should be proper regular monitoring during transfusions.

Anaemia workup to determine the specific cause is of critical importance, as pointed out in the principles of Patient Blood Management (4,15). Most of the patients were investigated for underlying causes in this study. Iron studies were conducted in 67.1% of the patients as well as other tests such as folate (59.2%), Vitamin B12 (57.9%) and reticulocyte production index (34.2%).

Haptoglobin was the most prevalent test ordered under a category of other. A significant number of patients thus underwent sufficient anaemia investigations appropriate for a District Hospital level before receiving red blood cell transfusion.

Another point of view suggests that most of these patients could be managed with alternative therapy based on their anaemia workup results (1,17). Oral iron supplement was administered to 81.6% of the patients. Unfortunately, parenteral iron was not yet available at the district hospital-level during the transfusion period. As a result, some patients received red blood cell transfusion instead of iron therapy only.

Folate therapy was also generously used (76.3%). Itis of great concern that only 15.8
% of the patients received tranexamic acid despite of the high number of patients presenting with a history of acute blood loss and strong evidence confirming that tranexamic acid limits

blood loss (16). Likewise, no patients received erythropoietin despite its benefit in renal failure patients, which was the admission diagnosis in 17 % of cases Only 2.6% of the patients received Vitamin B12, but it was tested in 57.9% of cases.

Triggers

The indication for transfusion in almost all patients (98.7%) was symptomatic anaemia in this study. The pre-transfusion haemoglobin was documented for all patients. The median haemoglobin was 4.6 g/dL (inter-quartile range 3.95-5.5g/dL). A similar study in Kimberly had 96% of patients with a transfusion trigger of symptomatic anaemia (3), where all patients had pre-transfusion haemoglobin documented, with a median value of 6.2 g/dL.

This is in contrast to the American College of pathologist study, which had a higher pre-transfusion median haemoglobin of 8.1 g/dL (inter-quartile range 2.3-16.5 g/dL) (11). Nevertheless, it is essential to note that haemoglobin value is not the only determining factor. Patients' comorbidities and clinical status are also vital factors (1). Thus, patients in this audit were transfused at significantly lower haemoglobin values than other studies.

Consent and Monitoring

All patients had a valid signed consent as well as two verification signatures. More than half of the patients (53%) had a single unit of blood ordered, in keeping with the World Health Organization recommended Patient blood management principles (4,15,17). On the other hand, forty-six percent of the patients received two units during a single episode, while only one patient received three units. The number of patients with two units is relatively high. Some practitioners might still be accustomed to transfusing two units as standard practice, and training might be beneficial.

All ordered units were transfused, with no wastage nor return to the blood bank. The post-transfusion haemoglobin value was documented in 55 out of 76 patients, with a median of 6.9 g/dL (inter-quartile range 5.4-7.9 g/dL), which is lower than a similar study of 8.3 g/dL (3). It

can be concluded that the patients benefited from transfusion considering that the post-transfusion haemoglobin is significantly higher than the pre-transfusion, which had a median of 4.6 g/dL (p Value <0.0001).

South African clinical guidelines (1) recommend that blood must be transfused within six hours. In contrast this study found a median transfusion time of 6.5 hours (inter-quartile range 4.0-9.0 hours), which might result in a compromised quality of blood products and potentially increasing the risk of transfusion-related adverse effects.

Monitoring of pre-transfusion vital signs was generally good, with 100% documentation. Most patients were adequately monitored as 98.7% of patients had vital signs during transfusion documented. A further decline occurred as only 93.4% of post-transfusion vitals were recorded. This compromises patients' safety, as complications might not be detected timeously, resulting in poor patient outcomes.

Outcomes

Only one case of adverse effect was reported during the study, when one patient developed chest pains. It might be that indeed adverse effects do not commonly occur at the facility, or that they were missed. Almost all patients (93%) were referred to other facilities or departments for continued care or further investigations. Only four patients (4%) were transferred out to other facilities as inpatients. The rest (95%) were discharged home and followed up at other facilities as outpatients. No deaths were recorded. The outcomes of most of those patients could not be traced.

Follow up at 30 days was a challenge as no data could be found on 75% of the patients. More than 6 % were re-admitted and 18% healthy.

This study described transfusion practices and evaluated adherence to the National South African transfusion guidelines (1). The audit revealed that 68% of the transfusion episodes

adhered to the guidelines whilst 32% did not. Improvement could possibly be achieved through continuous training and repeat audits, as was demonstrated by similar studies (3).

Strengths and Limitations

The study went into great depth to describe the transfusion practices. The audit tool was quite extensive as well, thus obtained a lot of relevant patient information. On the other hand, the sample size was small due to few transfusion episodes at the hospital and difficulties retrieving files.

Implications and recommendations

A clear, detailed transfusion protocol relevant for a district hospital and patient profile should be written. Regular training on Patient Blood Management is a necessity.

The physician should be educated on tranexamic acid, emphasizing that it limits blood loss but does not increase the risk of thrombosis.

Transfusing personnel should monitor the transfusion rate and the duration to six hours maximum. All transfusion-related adverse reactions are to be anticipated and documented, including ones with delayed onset.

Doctors to be advised to use single unit transfusion as often as possible.

Practitioners to be trained on the use of intravenous iron especially for patients with anaemia of chronic disease.

Conclusion

This study demonstrated that most of the transfusion episodes at National District Hospital adhered to the guidelines. However, there were still some gaps regarding the use of

alternative treatment and monitoring during transfusion. Future training of personnel might lead to improvements in practice followed by more audits.

Acknowledgements

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Competing interest

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Author contribution

NSM: Conceptualisation of the study, protocol, data collection, analysis, and manuscript writing as partial fulfilment of her MMed (Fam) degree.

DTH: Acted as the study leader, assisted with protocol review, report review and final manuscript.

FCR: Provided input regarding the aims and objectives, protocol review, data analysis and interpretation of results.

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Data availability

The data that support the findings of this study is available from the corresponding author, upon reasonable request.

Disclaimer

The views expressed in this article are that of the authors and not of the University of the Free State.

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APPENDICES

Appendix A: HSREC Approval

Appendix B: Free State Department of Health Approval

Appendix C: Data Sheet

Appendix D: Protocol

Appendix E: South African Family Practice Journal - Author Guidelines

Appendix F: TurnItIn Report

Appendix A: HSREC Approval

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UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Health Sciences Research Ethics Committee

24-Jul-2020

Dear **Dr Nonofo Madito**

Ethics Clearance: **A clinical audit of Red Blood Cell transfusion at National District Hospital**
Principal Investigator: **Dr Nonofo Madito**
Department: **Family Medicine Department (Bloemfontein Campus)**
APPLICATION APPROVED

Please ensure that you read the whole document

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is:**UFS-HSD2020/1109/2508**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4017794/5 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. SM Le Grange
Chair : Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | E: ethicsfhs@ufs.ac.za
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Appendix B: Free State Department of Health Approval

health
Department of Health
FREE STATE PROVINCE

08 July 2020

Dr N Madito
Dept. of Family Medicine
UFS

Dear Dr N Madito

Subject: A clinical audit of Red Bloood Cell transfusion at National District Hospital.

- Please ensure that you read the whole document, Permission is hereby granted for the above – mentioned research on the following conditions:
- Serious Adverse events to be reported to the Free State department of health and/ or termination of the study
- Ascertain that your data collection exercise neither interferes with the day to day running of **National Hospital** nor the performance of duties by the respondents or health care workers.
- Confidentiality of information will be ensured and please do not obtain information regarding the identity of the participants.
- **Research results and a complete report should be made available to the Free State Department of Health on completion of the study (a hard copy plus a soft copy).**
- Progress report must be presented not later than one year after approval of the project to the Ethics Committee of the University of the Free State and to Free State Department of Health.
- Any amendments, extension or other modifications to the protocol or investigators must be submitted to the Ethics Committee of the University of the Free State and to Free State Department of Health.
- **Conditions stated in your Ethical Approval letter should be adhered to and a final copy of the Ethics Clearance Certificate should be submitted to** sebeelats@fshealth.gov.za / makenamr@fshealth.gov.za **before you commence with the study**
- No financial liability will be placed on the Free State Department of Health
- **Please discuss your study with Institution Manager on commencement for logistical arrangements see 2nd page for contact details.**
- Department of Health to be fully indemnified from any harm that participants and staff experiences in the study
- Researchers will be required to enter in to a formal agreement with the Free State department of health regulating and formalizing the research relationship (document will follow)
- **As part of feedback you will be required to present your study findings/results at the Free State Provincial health research day**

Trust you find the above in order.

Kind Regards

Dr D Motau
HEAD: HEALTH
Date: 21/07/2020

Head : Health
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Appendix C: Data Sheet

DATA SHEET			
	Q1 Study number		
Section A			
	Q2 Date of transfusion		
	Q3 Age		
	Q4 Gender		
	Male		
	Female		
	Q5 Admission diagnosis	**Yes**	**No**
	Gastrointestinal bleed		
	Abnormal uterine bleed		
	Severe epistaxis		
	Renal failure		
	Pneumonia		
	Malignancy		
	Congestive cardiac failure		
	Abortion		
	Caesarean section		
	Others(*specify*)		
	Q6 Co-morbid conditions	**Yes**	**No**
	Hypertension		
	Diabetes		
	HIV		
	Chronic kidney disease		
	Malignancy		
	Congestive cardiac failure		
	Others(*specify*)		
Section B	**Q7 Pre-existing anaemia**		
	Yes(*specify*)		
	No		
	Q8 Indication for transfusion	**Yes**	**No**
	Symptomatic anaemia		
	Pre-operative patient		
	Others (*Specify*)		
	Q9 Anaemia work up done	**Yes**	**No**
	Iron studies		

	Folate		
	Vitamin B12		
	Reticulocyte production index		
	Others (*specify*)		
	Q10 Additional treatment	**Yes**	**No**
	Oral iron therapy		
	Folate		
	Vitamin B12		
	Erythropoietin		
	Tranexamic acid		
	None		
	others(*specify*)		
Section C	**Q11 Consent signed**	**Yes**	**No**
	Q12 Two verification signatures present	**Yes**	**No**
Section D	**Q13 Pre-transfusion Hb documented**	**Yes**	**No**
	Q14 Number of units ordered		
	Q15 Number of units transfused		
	Q16 Post transfusion Hb documented	**Yes**	**No**
	Q17 Transfusion time of each unit (hours)		
	Q18 Baseline vital signs recorded	**Yes**	**No**
	Blood pressure		
	Pulse		
	Temperature		
	Respiratory rate		
	Q19 Transfusion vital signs recorded	**Yes**	**No**
	Blood pressure		
	Pulse		
	Temperature		
	Respiratory rate		

	Q20 Post transfusion vital signs recorded	**Yes**	**No**
	Blood pressure		
	Heart rate		
	Temperature		
	Respiratory rate		
	Q21 Transfusion reaction recorded	**Yes**	**No**
	If yes(*specify*)		
	Q22 Number of units returned to blood bank		
Section E	**Q23 Adherence to the National Guidelines**	**Yes**	**No**
	Q24 Outcomes		
	Referred		
	Discharged		
	Died		
	Other*(specify)*		
	Q25 F/u in 30 days		
	No data		
	Re-admitted		
	Died		
	Healthy		

Appendix D: Protocol

A clinical audit of Red Blood Cell transfusion at National District Hospital

Research Protocol in partial fulfillment of the requirements for the degree MMed (Family Medicine) at the University of the Free State

Researcher:

Dr NS Madito

Registrar Family Medicine

University of the Free State

Study leader:

Dr DT Hagemeister

Department of Family Medicine

University of the Free State

Contents

Abbreviations

Hb	-	Haemoglobin
g/dL	-	Gram per deciliters
ml	-	Milliliters
SANBS	-	South African National Blood Services
HIV	-	Human Immunodeficiency Virus
CEO	-	Chief Executive Officer
FSDOH	-	Free State Department of Health
HSREC	-	Health Sciences Research Ethics Committee

1. Introduction

1.1 Indications for Red Blood Cell Transfusion

Red blood cell transfusion is one of the most critical and expensive live-saving treatment modalities, and it thus has to be used correctly, bearing in mind the risks vs. benefits and patient outcomes (1,2). Evidence suggests that Red Blood Cell transfusion predisposes patients to multiorgan dysfunction and acute respiratory distress syndrome (2).

The best medical practice would be to transfuse enough Red blood cells to improve the patient's clinical picture while avoiding unnecessary transfusions; studies from China and Europe revealed that more than 1/3 of Red Blood Cell transfusions were not indicated (3).
There are many factors to consider before deciding to transfuse a patient other than the haemoglobin, such as clinical condition, age, co-morbid conditions, baseline function, and the ability to compensate (4).

Literature has shown that restrictive transfusion was safe and yielded good patient outcomes even in older patients (3,4). The aim of transfusing red blood cells to anaemic or bleeding patients is to restore oxygen-carrying capacity, subsequently improving tissue oxygenation (1), and it also expands circulating volume, especially in bleeding patients (4,5). In critically ill patients red blood cell transfusion does not restore oxygen-carrying capacity and is instead associated with poorer patient outcomes (2).

Practitioners should perform proper and thorough investigations on all anaemic patients to identify and manage underlying causes instead of just transfusing the patient and leaving the cause unknown (1). Frail patients should only receive transfusions if they have severe symptoms, and other treatment modalities have not been effective (1).

Booked patients for elective surgical procedures need to be managed and investigated adequately as well as having their haemoglobin optimized before the surgical procedure,

those who undergo emergency procedures with haemoglobin of <8 need to be transfused (1). Obstetric haemorrhage is a life-threatening emergency; thus, there is the need to transfuse the patient when the haemoglobin is <6, and the patient is symptomatic (1).

There is a paradigm shift in transfusion medicine towards what is called Patient Blood Management (1,5,6). This evidence-based practice focuses on improving patient outcomes by preserving the patient's blood (5). It is not against transfusion but promotes appropriate transfusion and if implemented correctly will cut costs and improve patient outcomes (5,6).

1.2 Clinical audits on Red Blood Cell Transfusion

Transfusion of Red Blood Cells is associated with several risks, including transfusion reactions (1). Hence patient safety is of paramount importance, and there are checklists and other procedures that practitioners should follow before and during transfusion, in order to minimize these risks (1,2,4,7).

Audits done in this regard illustrated best practices such as identification of the patient, transfusion checklists and verification of the unit before transfusion (8). Interventions to ensure that the blood is transfused within 30 minutes of receipt and running it over 4 hours improves patient outcomes (7,8). However, deficits in knowledge with regards to transfusion practices remained (8–10).

The academic hospitals affiliated with the University of the Witwatersrand conducted a study on the knowledge about usage of blood and blood products amongst doctors of all levels (10). The study revealed that their experience was generally deficient, even though consultants did better than their juniors, which is comparable to other low-to-middle-income countries.

A similar study in Uganda assessed Oncologists' Knowledge and Practices regarding blood transfusion (11). Most Doctors admitted having knowledge gaps and needing more training in transfusion medicine, their decision to transfuse was thus based on peer influence and often

led to inappropriate transfusions. The absence of transfusion guidelines in their institution also contributed to inappropriate transfusions.

There were several other clinical audits done on red blood cell transfusion; including one at Kimberly Hospital Complex, South Africa (9). The study on chronically anaemic adult patients assessed if practitioners transfused according to guidelines, mainly triggered by Haemoglobin level <6.9 and symptoms of anaemia. The hospital adhered to transfusion guidelines and most of the transfusions were appropriate.

Palliative care practice in the United Kingdom conducted a national audit of red blood cell transfusion practice (12). The study evaluated the transfusion practices of several palliative centers and evaluated their alignment to guidelines. Anaemia of chronic disease was highly prevalent at 38%.

Unfortunately, most patients who received red blood cell transfusion did not have further investigations done such as iron studies, folate, Vitamin B12, ferritin and transferrin saturation, hence alternate treatment was no given even when indicated (12,13). An inappropriately low number of patients received Tranexamic acid even though they were actively bleeding or had recent blood loss despite significant evidence that it reduces blood loss (1,12).

Low haemoglobin was a common indication for transfusion in the majority of patients as well as shortness of breath, while fatigue was amongst the highly ranked signs (12,13). Most patients received two or more units without re-evaluations between transfusions, only 18% of patients had significant clinical improvement, and 32% of the patients died within 30 days (12).The study showed that red blood cell transfusion is not beneficial in patients with advanced disease and that doctors should do proper anaemia workup and restrict transfusions in chronically critically ill patients (12,13).

A study of the College of American Pathologists in 128 Hospitals audited Red Blood Cell transfusions to assess if the hospitals were compliant with the guidelines (14) with the focus being on haemoglobin as transfusion trigger. A median haemoglobin threshold of 8.0-8.9g/dL for patients of all categories was used, except for those with cardiovascular and respiratory disease, for whom a limit of 9.0-9.9g/dL was used. Sixty-nine percent of the Hospitals were found to be compliant.

The motivating factor for compliance could be that 35% of the audited institutions required conformance to guidelines for physicians to enjoy certain privileges (14). More countries are moving towards evidence-based practice and transfusing at lower haemoglobin levels and increasing single unit transfusion, as indicated in a study done in Finland (15).

Clinical audits and studies done in Obstetrics and Gynaecology specialties also indicate that patients are transfused inappropriately (16,17). A study in Bangladesh assessed the rate of unnecessary transfusions in admitted Obstetrics and Gynaecology patients to be 9.23%, comparable to other studies in the world (17). Sixty-four of the patients had pre-operative anaemia, and 24% had antenatal anaemia, which are both treatable causes, 46% of Gynaecology cases received transfusions secondary to miscarriages. Interventions were sometimes delayed or inadequate.

The post-partum period may pose significant risks for severe blood loss, a Dutch study found that 46% of transfusions were inappropriate partly due to over transfusion as their guidelines stated the transfusion trigger haemoglobin, but they did not indicate the target haemoglobin (14).

1.3 South African transfusion guidelines (1)

Transfusion triggers

- Haemoglobin < 6g/dL
- Haemoglobin < 7g/dL in intraoperative, post-operative and critically ill patients.

- Haemoglobin < 8g/dL in pre-operative patients with pre-existing cardiovascular disease or increased risk of blood loss > 500ml.
- Acute blood loss of > 30% of the blood volume in an adult.

Patient identification and verification

- Two signatures of personnel who conducted the verifications to appear on the form.
- A valid consent form should be in the patient's file.
- The practitioners should not transfuse the unit if there are any discrepancies.

Monitoring of the patient

- The patient's baseline vital signs to be recorded before commencing the transfusion.
- Record vital signs throughout the procedure, every 15 minutes for the first half hour, then every 30 minutes.
- Transfuse within 6 hours.
- Report All transfusion reactions accordingly.

1.4 Problem statement

National District Hospital is a level 1 Hospital in Bloemfontein. It is situated 3.9km away from Universitas Academic Hospital, a central hospital providing the highest level of care in the Free State province. The blood bank servicing National District Hospital is at Universitas Academic Hospital.

There is 1 unit of Red Blood Cell available on-site for emergency transfusion purposes at any given time. During the three months from 1 October 2019 to 31 December 2019, 79 patients were transfused costing the hospital R171,187.96 according to the statistics provided by the CEO of National District Hospital.

The absence of a blood bank on the hospital premises and the limited emergency blood supply was motivation to investigate whether our patients are assessed appropriately, and

alternative treatments are used as recommended. The high cost of red blood cell transfusion as well the associated potential risks were also motivation for this study. Therefore, improving healthcare practitioner's knowledge of transfusion medicine will lead to better practice.

The study should then answer the question: Are Red Blood Cell transfusions at National District Hospital done appropriately?

2. Aims and Objectives

2.1 Aims

To evaluate the Red blood cell transfusion practice and patient's outcomes at National District Hospital, and to determine adherence to transfusion guidelines.

2.2 Objectives

2.2.1 To describe the current practice of blood transfusion.

2.2.2 To evaluate post transfusion outcomes of patients at National District Hospital.

2.2.3 To determine current transfusion triggers and co-relate them with the National Transfusion Guidelines.

2.2.4 To assess whether the National Transfusion Guidelines were adhered to.

3. Methodology

3.1 Study design

A retrospective descriptive study.

3.2 Study population and sample

Study population for this research are all patients who received blood transfusion at National District Hospital. The sample will consist of all patients who received Red Blood Cell Transfusion at National District Hospital between 1 June 2019 and 31 December 2019. The estimated sample size is 100 over a 6 -month period.

Inclusion criteria: All patients and any clinical condition will be included in the study.

Exclusion criteria: Patient's whose files are missing will be excluded from the study.

3.3 Measurement

The researcher will compile a list of all patients who received Red Blood Cell transfusion using the Blood transfusion registers in the wards of the hospital. Additional information will be obtained from blood product request forms from the South African National Blood Services (SANBS), including the indication, pre-transfusion haemoglobin and number of units ordered. The pre-transfusion haemoglobin on the request form will be correlated with the one on file or laboratory records. The researcher will retrieve patients' files from the admission department.

The researcher will do all the data collection without a research assistant.

A hard-copy based data sheet (Appendix 1) will be used to extract relevant information from the patient's files, which will then be transferred on to an Excel spreadsheet. The datasheet was developed using information from the literature review and the South African National Blood Service Clinical Guidelines for the use of Blood Products in South Africa. No other patient details will be captured on the data sheet, which will only carry a study number.

A master file with the names of the patients and their study number will be kept strictly separate and only be used to identify relevant files during the data collection. Colour-coded stickers will be placed on files that have been captured to avoid duplication.

The data sheet will consist of 5 sections:

- **Section A** will gather information regarding the patient's characteristics such as age, gender, admission diagnosis and co-morbid conditions.

- **Section B** will get more information regarding transfusion triggers. The researcher will check if the patient had pre-existing anaemia, symptomatic anaemia, if anaemia work-up was done such as Iron studies, Folate, Ferritin, Vitamin B12 , transferrin saturation and full blood count and alternative treatment given where indicated.

- **Section C** deals with patient identification and verification. Consent form and verification signatures from 2 practitioners.

- **Section D** will measure patient monitoring. This includes pre-transfusion Hb, number of units ordered, number of units transfused, number of units returned to blood bank. The transfusion duration as well as vital signs before, during and post transfusion will be assessed.

- **Section E** measures patient's outcomes. It will assess if the patient was discharged, re-admitted , referred, died and if the National Guidelines were adhered to.

The researcher will conclude on the appropriateness of the transfusion based on adherence to the South African Transfusion Guidelines.

3.4 Methodological and measurement errors

Some patient's files may be missing due to poor record-keeping, and that might affect the results. Some files might have incomplete information. There is a possibility of patient's names to appear on the blood bank register but not on the ward register.

3.5 Pilot study

A pilot study will be done after the approval by the Health Science Research Ethics Committee and the Free State Department of Health to assess the practicalities of data collection and tools. Ten data forms will be completed from patients that were transfused in June 2019, and the data will be included in the main study.

4. Data analysis and interpretation

The analysis will be done with the assistance of the department of biostatistics at the University of Free State. An electronic datasheet will be created with Microsoft Excel. Continuous variables will be summarised by means, standard deviations or medians and percentiles. Categorical variables will be summarised by frequencies and percentages.

5. Data management

Patient confidentiality will always be maintained. Each patient will get a study number. There will be no identifiable patient's details used on the data collection sheet. The information will be collected from the patient's file at the hospital and transcribed to a datasheet. The datasheets and the master file will always be kept in a safe place, even when the study has been completed. The patients' files will not be removed from the hospital and will be in a locked office during data collection. The data in the Excel will be protected by means of a computer password. There will be no patient identifiable details even when results are published.

6. Implementation of findings

The results will be made available to the management of National District Hospital, as well as appropriate recommendations. A report will be submitted to the University of the Free State as part of the criteria for the Masters in Family Medicine degree. The information might also be presented at conferences and published in an appropriate journal.

7. Budget

The projected costs of the project are below. The researcher will cover the expenses but may also request funding.

Expense	Cost
Telephone and Data	R 2 000
Binding of thesis	R 2 250
Stationary (Printing of data sheets and literature articles)	R 750
Travel (Travel for data collection)	R 200
Total	R 5 200

8. Time Schedule

January - November 2019	Planning and literature review						
December 2019- April 2020		Writing of protocol					
May-July2020			Submission to HSREC and FS DOH				
August 2020				Pilot study			
September 2020- November 2020					Data collection		
December 2020						Data analysis	
January 2021- March 2021							Research report

9. Ethical Aspects

The protocol will be submitted to the Health Sciences Research Ethics Committee at the University of Free State for approval. Permission to conduct the study will also be obtained from the Head, Free State Department of Health. No informed consent from the patients will be required as it is a retrospective study of patients' clinical records. Colour-coded stickers will be placed on files that have been captured to avoid duplication.

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Appendix E: South African Family Practice Journal

Overview

The author guidelines include information about the types of articles received for publication and preparing a manuscript for submission. Other relevant information about the journal's policies and the reviewing process can be found under the about section. The **compulsory cover letter** forms part of a submission and must be submitted together with all the required **forms.** All forms need to be completed in English.

Original Research Article

Report of original scientific research conducted in family medicine and primary care, ethical approval essential. **See full structure of original research articles below.**

Word limit	7000 words (excluding the structured abstract and references)
Structured abstract	250 words to include a Background, Methods, Results and Conclusion
References	40 or less
Tables/Figures	no more than 7 Tables/Figure
Ethical statement	should be included in the manuscript

Cover Letter

The authorship, disclosure statements, copyright, and license agreement form is our compulsory cover letter which needs to form part of your submission. Kindly download and complete, in English, the provided **form**.

Anyone that has made a significant contribution to the research and the paper must be listed as an author in your cover letter. Contributions that fall short of meeting the criteria as stipulated in our policy should rather be mentioned in the 'Acknowledgements' section of the manuscript. Read our **authorship** guidelines and **author contribution** statement policies.

Original Research Article full structure

Title: The article's full title should contain a maximum of 95 characters (including spaces).

Abstract: The abstract, written in English, should be no longer than 250 words and must be written in the past tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter.
The structured abstract for an Original Research article should consist of four paragraphs labelled Background, Methods, Results and Conclusion.

- Background: Summarise the social value (importance, relevance) and scientific value (knowledge gap) that your study addresses.
- Methods: Clearly express the basic design of the study, and name or briefly describe the methods used without going into excessive detail.
- Results: State the main findings.
- Conclusion: State your conclusion and any key implications or recommendations.

Do not cite references and do not use abbreviations excessively in the abstract.

Introduction: The introduction must contain your argument for the social and scientific value of the study, as well as the aim and objectives:

- Social value: The first part of the introduction should make a clear and logical argument for the importance or relevance of the study. Your argument should be supported by use of evidence from the literature.

- Scientific value: The second part of the introduction should make a clear and logical argument for the originality of the study. This should include a summary of what is already known about the research question or specific topic, and should clarify the knowledge gap that this study will address. Your argument should be supported by use of evidence from the literature.

- Conceptual framework: In some research articles it will also be important to describe the underlying theoretical basis for the research and how these theories are linked together in a conceptual framework. The theoretical evidence used to construct the conceptual framework should be referenced from the literature.
- Aim and objectives: The introduction should conclude with a clear summary of the aim and objectives of this study.

Research methods and design: This must address the following:

1. Study design: An outline of the type of study design.
2. Setting: A description of the setting for the study; for example, the type of community from which the participants came or the nature of the health system and services in which the study is conducted.
3. Study population and sampling strategy: Describe the study population and any inclusion or exclusion criteria. Describe the intended sample size and your sample size calculation or justification. Describe the sampling strategy used. Describe in practical terms how this was implemented.
4. Intervention (if appropriate): If there were intervention and comparison groups, describe the intervention in detail and what happened to the comparison groups.
5. Data collection: Define the data collection tools that were used and their validity. Describe in practical terms how data were collected and any key issues involved, e.g. language barriers.

- Data analysis: Describe how data were captured, checked and cleaned. Describe the analysis process, for example, the statistical tests used or steps followed in qualitative data analysis.
- Ethical considerations: Approval must have been obtained for all studies from the author's institution or other relevant ethics committee and the institution's name and permit numbers should be stated here.

Results: Present the results of your study in a logical sequence that addresses the aim and objectives of your study. Use tables and figures as required to present your findings. Use quotations as required to establish your interpretation of qualitative data. All units should conform to the **SI convention** and be abbreviated accordingly. Metric units and their international symbols are used throughout, as is the decimal point (not the decimal comma).

Discussion: The discussion section should address the following four elements:

- Key findings: Summarise the key findings without reiterating details of the results.
- Discussion of key findings: Explain how the key findings relate to previous research or to existing knowledge, practice or policy.
- Strengths and limitations: Describe the strengths and limitations of your methods and what the reader should take into account when interpreting your results.
- Implications or recommendations: State the implications of your study or recommendations for future research (questions that remain unanswered), policy or practice. Make sure that the recommendations flow directly from your findings.

Conclusion: Provide a brief conclusion that summarises the results and their meaning or significance in relation to each objective of the study.

Acknowledgements: Those who contributed to the work but do not meet our authorship criteria should be listed in the Acknowledgments with a description of the contribution. Authors are responsible for ensuring that anyone named in the Acknowledgments agrees to be named. Refer to the acknowledgement structure guide on our *Formatting Requirements* page.

Appendix F: TurnItIn Report

A clinical audit of Red Blood Cell transfusion at National District Hospital

by Nonofo Madito

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